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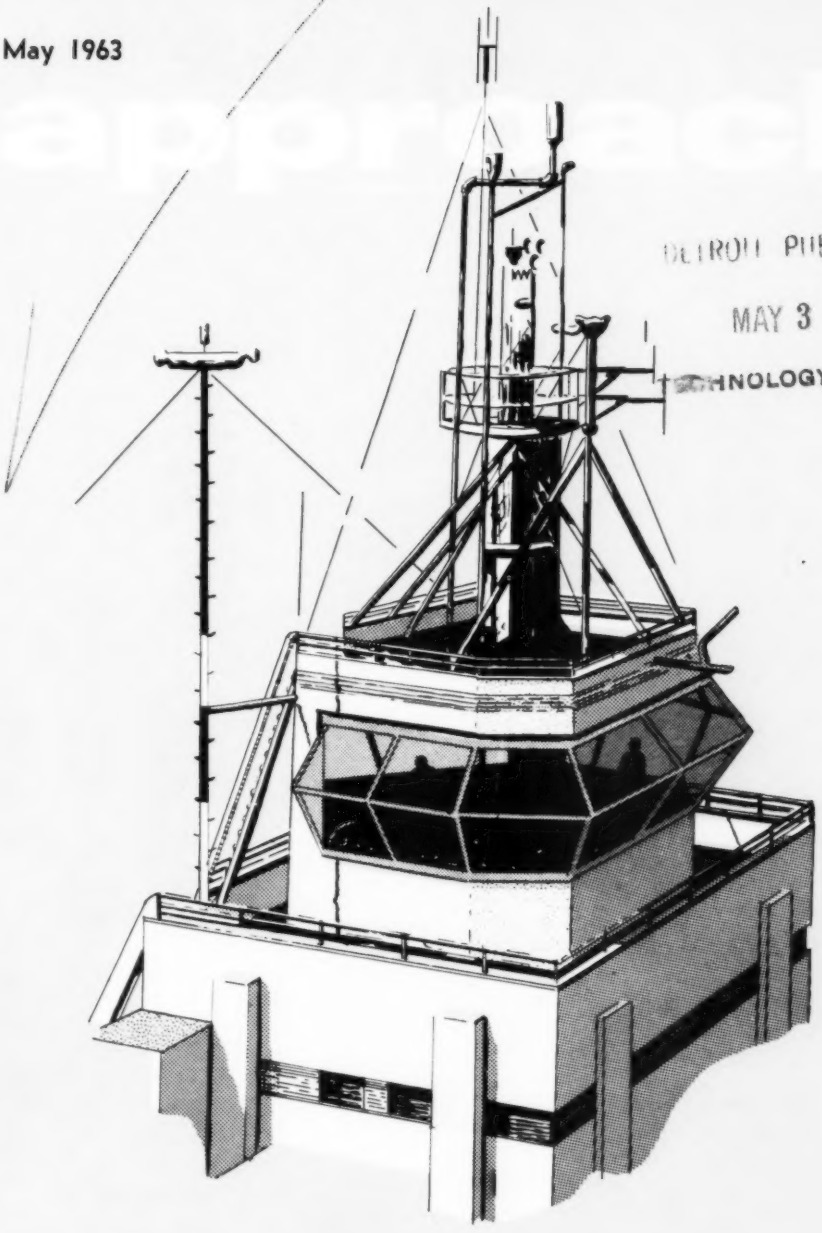


- Wash or Pit?
- What's the future of naval aviation?
- Solving the flight deck crunch problem
- DD to the rescue
- How do control tower operators occupy their spare moments?

TOWER TIMES

How do control tower operators occupy their spare moments?

by Jack Le Barron
Control Tower Operator No. 1409943

There is no doubt that every pilot, at one time or another, has directed pungent remarks toward the tower (not on the air, of course!) and fumed: "What do they do up there all day, think of ways to harass pilots?"

Now friction and error do occur occasionally, to deny it is to admit never having worked in a cockpit or control tower, but in the main there is mutual respect between the two groups who are aiming for the same goal even though they happen to be working different sides of the street. The pilot side of the street has been discussed enough for it to be familiar. What of the controller side? Is it a smooth, easily-traveled path or is it also studded with obstacles and pitfalls? Let's look at some past errors and see whether tower operators walk an "easy street."

Basic radio communications can be a pitfall. Since the spoken word is so important, a recent report on communications practices is of interest. This report analyzed some 300 hours of tape recordings of actual ground-air transmissions at a busy civilian airport.

Perception effectiveness was determined by whether either communicator requested "say again." The most important factor in perception was "expectedness." When words were familiar, the message was understood at much lower signal quality than when either words or content were unexpected. Now you know why there is a stress on standardized phraseology. Sometimes it's hard enough to unravel standard phrases when they've been hashed through an oxygen mask mike, blurred by a cranky ARC-27, and then squeezed through a speaker in the tower, only one of several loudspeakers which may be operating simultaneously.

Another type of communication confusion can emerge when a message passes through several people and the meaning gets garbled. An A-4 (A4D) pilot taxied out for some loft bombing but the squadron duty officer called NAS operations duty desk and requested the tower to direct the pilot to "abort his mission because the LABS gear was out."

This message went through the duty desk, up to the tower to the ground controller then over to the local controller. The local controller had just cleared the aircraft for takeoff and the message to abort the mission was delivered in a way the squadron duty officer had not foreseen. "The aircraft was just lifting," said the controller, "as I told the pilot to abort his takeoff."

Reaction in the cockpit was immediate. The pilot thought there was something about his aircraft which warranted immediate emergency procedures. Power went to idle. Gear, flaps and hook were lowered and touchdown came with about 2500 feet of runway remaining. The plane went into the abort gear at about 30 knots and crash trucks arrived within 60 seconds to put out a fire in the starboard brake assembly.

After studying the circumstances the squadron felt the incident could have been prevented if the duty officer had used different terminology in his request to the tower. Words such as "notify ..... that his LABS gear is inoperative" or "tell ..... that his mission has been canceled" would have been appropriate. "It cannot be assumed," continued the report, "that all personnel are familiar with and understand the relative importance of common squadron terminology."

In another case a tower operator noted an unusual flame pattern extending from the tailpipe of a jet which was in the process of taking off. He transmitted: "Number ....., you were arcing on takeoff." Neither the pilot nor his flight leader understood the implications. The pilot indicated later that the term "arcing" conveyed the impression that he was swerving or oscillating on takeoff; he at no time associated "arcing" with fire or the control difficulties which subsequently forced him to eject.

These two isolated examples do not, of course,

outweigh the countless occasions where a tower operator's correct and timely warning has alerted a pilot to unsuspected trouble. Many times this may seem to be taken for granted but pilots know the value of such assistance and recognition is often included in accident or incident reports as in this example: "It is felt that actions of the control tower operator in noting the smoke and immediately notifying the aircraft, enabled the pilot to secure the engine before the failure had progressed further and made the (landing) situation critical. . . ."

When trouble comes to a pilot the control tower operator tries to offer all assistance possible. As noted in the Manual of Air Traffic Control Procedures, it is impossible to prescribe procedures which will cover every situation. The number of variable factors which may affect such situations, and the degree to which each may apply, are often such that of necessity some areas of action must be left to the discretion of air traffic control personnel.

What more in the way of quick cooperation would you want than is evident in this report written by a tower operator: "At 1645 an A-1 (AD) called and advised he had an emergency, a very rough running engine. He reported his position as 6500 feet, 5 miles south of the field. The aircraft was given surface winds, altimeter setting, and cleared to land on any runway . . . all aircraft in the traffic pattern were advised to orbit at 1500 feet. An aircraft on final approach was requested to make a right turn out and try to intercept the emergency aircraft since it was doubtful he would make the field."

Such helpfulness on the part of the controller has not always been considered proper procedure when dealing with a straight-in approach. In fact the whole subject of straight-in approaches is a tricky one to discuss.

The tower has a natural inclination to ease the task of a pilot in trouble and the words "cleared straight-in" may seem very appropriate. However, several accident boards have commented adversely on this practice. They felt the straight-in, particularly under single-engine condition at night, is an accident potential.

But not all accident boards feel the same way. Under nearly identical engine-out conditions the fact of a straight-in being volunteered by the tower may not be questioned. What it amounts to then, is that the controller exposes himself to criticism if he offers a straight-in and the pilot bashes the airplane by landing short or being fast and overshooting.

Although the tower operator is not considered to have directly "caused" the accident in the event this does happen, he may be tagged as a contributing

factor or politely told that he made an error in judgment. Said one accident report: "The board members concur in the opinion that this accident was caused by a chain of events which started when the pilots attempted to make a straight-in approach. The tower operator's transmission offering a straight-in may have influenced the pilots in their decision to attempt one; however, the responsibility for accepting a straight-in approach rests solely with the pilots."

After some accidents, particularly the wheels-up type, there is a tendency to expand the air controlman's areas of responsibility through additional voice transmissions or visual checks of aircraft. For instance, one accident board recommended the tail hook override switch be mandatory on all night flights and that tower operators be briefed on its

use to aid in recognizing a wheels-up approach. However, this is no true solution. The location of the tower in relation to the approach end of the active runway would be the determining factor in the ability of tower personnel to observe the approach light.

Recommendations of this nature run all the way from having tower personnel direct pilots to re-enter the traffic pattern when they appear confused (hoboy! Imagine some of the phone calls this would bring when the "confused" pilot finally got down) to modifying the old phrase "re-check gear down, cleared to land." Suggested revisions include "re-check your gear *handle* down" and "*retouch* your gear handle."

One air station suggested having the tower say: "If checkoff list is complete, you are cleared for takeoff." Another station instructed the tower to end transmissions to pilots in emergency conditions with: "Remember your checkoff list."

All these were undoubtedly made from a sincere belief that they would prevent future trouble and individually they may appear to be useful. Collectively, however, they pile words upon words and if every suggestion were officially adopted the tower frequency would soon be saturated with a one-way conversation from the ground.

Self defense may oblige tower operators to make certain they give one particular transmission when it is appropriate: If no wheels watch is on station at the approach end of the runway being used, say so loud enough for it to get on the tape recorder. The following two examples give the reason why.

An A-4 (A4D) made a normal break, called gear down at the 90, and subsequently made an unintentional wheels-up landing. As you might have heard, *Skyhawks* sustain little or no damage when making a no-gear touchdown and all that resulted was an Incident report (two drop tanks, two antennae and the air refueling probe replaced).

One of the possible cause factors given was the fact that "The wheels watch was not on station due to a recent runway change. The information was not passed on to the pilot with a reminder to recheck gear." Naturally a recommendation was made for the tower to state "wheels watch not in place if that is the case. . . ."

For practical purposes the second case is identical except that the aircraft was an F-8 (F8U). Just prior to touchdown the pilot realized his gear was not down and he applied power. The jet settled onto the runway, slid a couple thousand feet on the belly, and finally became airborne. The next landing was made with the wheels down.

Unfortunately, this was no mere incident. With the *Crusader's* underside carved out it was an accident carrying a price tag of 100,000 bucks. As with the other case, the runway had recently been changed and a runway watch was not on station at the approach end; neither had the tower made any mention of the absence of the wheels watch.

It was agreed the final responsibility for lowering the wheels prior to landing rests with the pilot but the tower ultimately had to shoulder part of the blame: "Tower personnel were aware that a change of runway involved a 20-minute delay in posting the wheels watch at the new runway in use.

"The controller should have alerted the pilot that the runway wheels watch was not posted and one of the controllers should have paid special attention to the landing aircraft. . . . This accident has been

recorded indicating the pilot and tower personnel as contributing factors." If you were that controller the decision of the board would certainly do nothing to brighten your day at the bird farm.

Respecting these philosophies, it has to be agreed that tower operators must check landing aircraft with more than a casual glance. But landing aircraft is only one part of their problem. They must be equally alert in the case of departing aircraft and this is also more than idle watching. Statements in various accident reports indicate how this monitoring has almost become a technical matter.

- "Tower operators should be instructed and trained to advise pilots experiencing inflight fires as to the extent, progress and location of the fire."
- "It is agreed that had the pilot been informed of the fire immediately, the crash could possibly

have been averted. Upon interrogation, the tower operator stated that one burst of flame was seen just after the aircraft became airborne, but since it did not reappear and the aircraft continued in a normal climb the tower operator assumed that no emergency existed."

- "The training program for tower operators has been amplified to include instructions that will standardize the terminology utilized by the tower operators when informing pilots of possible emergency situations upon takeoff or landing. . . ."

So now we have the tower checking landing aircraft and monitoring departing aircraft. Those on landing rollout cannot be ignored either.

During a busy period around an east coast jet base a flight of three A-4s (A4D) had made two orbits over the field and were finally cleared into the pattern separately. The no. 3 man was cleared to land and the tower operator said: "I turned from watching the last half of his rollout so as to check other aircraft in the traffic pattern." But no. 3 was in difficulty with a failed starboard brake. The pilot shut down and attempted directional control with right rudder but the jet drifted to the left and went off the side of the runway. It flipped to the right and came to rest inverted. No transmissions had been made by the pilot during this hectic time.

The no. 2 pilot had cleared the runway and was taxiing to the line when he turned to look at no. 3. He saw it go off and roll over. "I had stopped," he said, "and was listening to my radio to see if ground control had stopped the traffic on the field. I heard nothing, so switched to tower frequency. The tower was still clearing aircraft for landing. It seemed as if no one had seen the accident so I called the tower and told them." Actually, members of the crash crew had seen the accident and were on the way. The pilot was extracted unhurt.

"The failure of the duty controller," wrote the station skipper, "to follow the aircraft through final rollout is not in accordance with current tower procedure. This is an isolated instance and corrective action has been taken."

Next, the pilot needs to be told of obstructions.

On a dark, moonless night a jet touched down on the left side of a 200-foot wide runway. About 2500 feet from the approach end, rolling about 80 knots, the aircraft collided with a portable field mirror. The mirror was about 25 feet inside the runway lights on the left side of the runway and was unlighted and unmarked: The tower did not warn the pilot of this obstruction on the runway.

Tower personnel had not been notified of the exact position of the mirror and were unaware that it was inside the runway lights. Nevertheless, the accident board held that, "it is the responsibility of the tower and the ODO to insure that the field is maintained in a clear and ready condition, to keep themselves properly informed of the condition of the field, position of hazards and obstructions, and to insure that all pilots are informed of these conditions. . . . It is apparent that any one of a number of personnel could have exerted a little more effort and passed the word on the condition of the field."

And sometimes when the tower very efficiently puts out information on obstructions it turns out to be bum dope. One cold, clear east coast night, an A-1 (AD) checked two miles out for landing. A good snowfall had blanketed the countryside and the con-

dition of the runway was a major factor to consider in this landing. The duty runway was 300 feet wide but it was plowed clear for only 150 feet according to information passed to the tower.

"Is that plowed path down the center?" asked the pilot.

"Affirmative," replied the tower, "150 feet wide, in the runway center. Braking action reported good."

Unfortunately, the cleared portion was only 128 feet wide and it was not in the center, being clear 90 feet to the right of centerline and 38 feet left of centerline. The pilot landed 45 feet left of runway centerline in three to four foot snowbanks and . . . whoomp! The right gear collapsed.

How the tower came to be given erroneous information was not brought out in the accident report but an endorsement made no bones about who was at fault: "The primary cause factor of this accident was the inaccurate and incomplete runway information given the pilot by the tower."

Is this carrying things too far? Involving tower personnel in the intricacies of post-accident investigation makes it easy for attention to be diverted from one area to another.

In this respect how would you grade the following episode?

While waiting for takeoff clearance the pilots of a jet trainer observed a mound of dirt, 130 feet from the takeoff end of the runway, extending across the entire width of the runway. Both pilots heard the tower caution landing aircraft to observe the obstruction at the approach end of the runway.

About 55 minutes after takeoff the jet returned for practice landings. On the second approach a high sink rate set in near the end of the runway. Full throttle failed to stop the settling and the aircraft struck the mound of dirt. Both main gear sheared, the plane bounced and the nose wheel buckled from impact with the runway. The now battered jet slid 2500 feet to a stop.

Both pilots commented on the fact that at no time while they were in the pattern did the tower notify them of the trench and five-foot high mound of dirt. The accident board commented that, "Even though both pilots had observed the mound prior to takeoff, it is considered a fresh reminder by the tower may have had considerable bearing on the type approach made."

Well, maybe and maybe not.

Details of the construction were on a NOTAM and the mound was marked in accordance with existing

directives. Tape recordings on tower primary frequency indicated that several types of aircraft of varying airspeeds, both props and jets, were within the control zone at the time of the accident. Due to heavier than normal traffic the tower operator did not transmit the obstruction warning *directly* to the pilots of the jet trainer. However, the warning was transmitted at least twice during the period of time they were within the traffic pattern and they should have been monitoring all transmissions over the primary tower frequency.

Whether you score the previous example "for" or "against" the tower, we can return to our original question "What sort of a road does the controller follow" and see that he faces a multitude of pitfalls and pratfalls. Errors by aircontrolmen cannot be overlooked. But neither can we overlook the effect of an adverse comment which is thin on facts, heavy on conjecture, and implies a weakness in the controller's ability. Supervisory personnel may be moved to stress one aspect of air operations so strongly that another aspect is weakened. This results in "dike-plugging" rather than "flood control."

BLOCKED RUNWAY

A blocked runway is the boogie man around a jet field, where the action is rapid and fuel goes fast. One thing is worse—an unknown blocked runway, usually in low visibility or at night.

This rhubarb took place at night. There was an overcast at 2000 feet but visibility was good with 12 miles. An F-8 (F8U) was shooting a practice GCA to a full stop and several aircraft were making touch-and-go's. The GCA traffic touched down and rolled out but the pilot suddenly noted cockpit light failure plus an engine flameout.

He coasted over to the left side of the runway and stopped about 2000 feet from the end. There is the real possibility that the flameout was due to inadvertent shutdown.

Nevertheless, there was no need trying to punch out a message to the tower that the runway was blocked. The F-8 has no battery and when the engine runs down there is no juice to be had. Armed with a flashlight the pilot vacated the cockpit and tried to signal the tower and other aircraft. He had no luck. The tower remained blissfully unaware that anything was wrong although there may have been some uncertainty when there was no switch from GCA over to ground control for clearance back to the line.

About this time a C-130 (GV) which had been cleared for a touch-and-go, lifted off the runway for another circuit. Another F-8 (F8U) was then cleared to land full stop.

Well, he made the rollout O.K. and notified the tower in strong terms that there was an aircraft on the runway. Under normal circumstances this probably would have triggered off immediate action in the tower—it would account for the unaccounted.

Unfortunately, there had been an earlier F-8 (F8U) which had stalled clear of the runway and was in the process of being towed back to the flight line. Tower personnel apparently suspected the latest arrival to be talking about this one. However, the tower did dispatch a vehicle to investigate the report.

Meanwhile, back in the pattern, the C-130 (GV) was cleared for a full stop and it did so, turning off short of the stalled aircraft. Following the C-130 (GV) was yet another F-8 (F8U) which was cleared to land. Along with his clearance the pilot was told there was a report that the runway was blocked. Sort of like asking a drowning man how deep the water is. He went ahead and landed and verified the report the hard way—by smacking into the stalled F-8 (F8U). Total time from blockage to collision: 15 minutes. No injuries, two F-8's (F8U) needing overhaul.

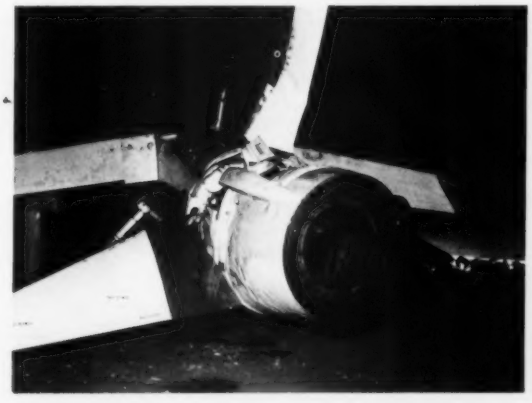
Next time the pilot who stalled will probably use his day-night flares to let somebody know. And the pilot who rammed the flamed out aircraft will probably insist that the tower find out for sure whether or not the runway is clear.

As for the tower people, it is enough to quote several paragraphs from a training manual to see their errors of omission (in the absence of a known Navy manual a USAF type is quoted).

"The possibility that an aircraft may have mechanical difficulty on the runway is always present . . . If an aircraft is not satisfactorily accounted for, base operations will be advised immediately and use of the runway discontinued until it is determined that the aircraft is not on the runway. . . .

"The control tower operator may use the tower spotlight to determine if a runway is clear during night operations, provided it will illuminate all portions of the runway. If not, base operations will be requested to send a vehicle to conduct a physical inspection of the runway. Until the inspection is completed and base operations reports that it is clear, the runway will not be used."

Note to tower operators: How many models of aircraft do not come equipped with batteries?



Bashed from behind, U-bird gets rumpled tail feathers.

It's the Little Things...

VMF-451 logged over 20,500 accident-free hours in *Crusaders*. Here is the philosophy that this squadron utilized to maintain a safe, combat ready outfit. Operations during this period covered everything from the first transpacific flight by a single engine fighter squadron and numerous Carquals to routine day-to-day hot pad operations.

By Capt. Bill Gash, USMC

What makes the difference between two highly trained professional aviators? Can it be that special tactic or technique that one has perfected to the nth degree? The answer may be "it's the little things" that we must solve and overcome if we are to continue the yearly reduction of the aircraft accident rate in military flying. It would appear that we are still having the same accidents as we had 20 years ago or for that matter since naval aviation began. These accidents have been drastically reduced in number but if we are to keep this downward trend progressing we must concern ourselves with these problems.

Professionalism is what we try to instill in the young aviator fresh from the training command. We try to impress him with *professionalism* but he has to learn that it is composed of the "little things" in the aviation business. Perhaps you are wondering just how these little things affect a squadron or unit. When we take a good look we soon realize that this is the difference between an accident-free squadron and one that has accidents.

How many times have you heard this in the squadron readyroom. "I know what they *say*, but everybody does it"? This is the word or procedure until an accident occurs, then, as the old saying goes, all the dirty laundry is out in the open. Then, we find that the pilots are not wearing anti-G suits, not carrying pistols on night flights nor complying with published directives and SOPs. We also find that maintenance personnel are not using HMI, squadron instructions or published directives. We may find that they have been taking a few shortcuts to keep the planes in the air. So, we have an investigation *after* we have lost an aircraft and possibly a fully qualified pilot. What was the reason for this acci-

Training and esprit de Corps pay handsome rewards.

dent? It could be anything from flathatting to an engine seizure.

I can sense most people's reaction to this—these are not little things—and I must agree. The accident could be the direct result of noncompliance with squadron operating procedures, not utilizing the HMI or perhaps, it was one of those "shortcuts" which were taken to keep the aircraft in the air. By the time we recognize some of "the little things" they may be shrouded by a large hole in the ground and a pile of wreckage. What can we do about the situation? I am certain each squadron commander, group or wing commander has a solution to this problem. I do not intend to offer one solution for all the problems which aviators may be confronted with in the endeavor to eliminate these "little things." But, I can offer you a solution that one unit has used for almost three years.

In November 1959, VMF-451 was re-formed at MCAS El Toro after completion of an overseas tour. When this squadron re-formed it became the proud owner of 22 F-8D (F8U-2N) aircraft and a cross-section of officers and enlisted experience ranking from the fresh out of schools type, to the "old salt" with one tour or more in a U-bird squadron. The squadron began the training cycle with which we are all familiar, train two and transfer one. This sum reaches a point of diminishing returns and in many squadrons this is one of "those little things."

This squadron began its training cycle and as the days passed so did squadron personnel, new people arriving daily and old hands departing. We made mistakes as any other squadron makes mistakes. In many cases we made the same mistakes over again or we made mistakes that had been made by adjoining squadrons flying similar aircraft under the exact same conditions. *This learning process is a costly one.* It soon became evident that we did not have enough aircraft or personnel to make all the mistakes ourselves and something must be done about these little things that kept popping up daily. Most of these little things showed a lack of training, supervision, leadership and pride within the squadron.

The next problem was how to attack these little things or how to get the ball rolling in the right direction. You can not just come to work some morning and call a general muster and make the announcement there will "be no." It takes leadership, supervision and better training. Since everything still starts at the top and flows downhill these essentials must begin at the commanding officer's level.

He is the individual that must direct and control the unit. Leadership and esprit de corps are intan-

Through supervision...

Leadership and training...

little things can be eliminated.

Well trained professional pilots

gibles of command. The two commanding officers of this squadron during this period started the ball rolling and even though their methods to control and authoritatively direct the squadron differed, the result has been the same. Neither eliminated all these little things alone, but did provide the leadership and direct the attack. This was the first link in the chain which ended with the most junior man in the squadron. We have discussed the program from the commanding officer's point of view, now let us consider those of the officers and pilots.

Each officer within the squadron is responsible to the commanding officer for one or more duties. These duties may vary but each officer was made aware of his responsibilities. You may ask how does this affect our squadron and the elimination of those little things? The first step included training, instruction and development of truly professional officers and aviators. The result—professional well trained aviators did not have to be constantly watched or monitored for fear of violating instructions. Our aviators ranged from the fresh Second Lieutenant from the training command to pilots with years of experience in fighter aircraft.

That nucleus or cadre of experienced officers have been instrumental in training and developing the squadron and professional aviators we now have. This can be classified as leadership, professionalism or any number of terms but basically it is a group of well-trained, mature aviators that followed the book and when necessary revised the book. With a group of well trained, professional aviators you soon find that many of the little things are no longer in evidence, in fact they do not exist, because they cannot exist side by side with professionalism.

There are many ways of attaining any goal, but aviation is unforgiving in many ways; therefore we can eliminate the majority of the methods without further consideration. The average pilot can be expected to perform as he has been instructed/guided. The majority will not forget about those little things with positive leadership. The young pilot feels he has a charmed life and he must prove himself as well as try everything he has heard. Each young pilot wants to be a "tiger" but can he become a tiger by complying with routine normal instructions and SOPs? The young pilot must be trained and even more important he must be most aware of what is expected of him. He must realize that his unit has absolutely no place for him if he does not have a professional, mature outlook.

The next link in this chain is the Staff NCO. I have stated that leadership begins with the Commanding Officer, but it must not end with the Commanding Officer nor become stale within the officer ranks. Leadership is a necessity for the Staff NCO, he must be the connecting link between the department head and the junior ranks. He must supervise, instruct and know the people that work for him. To accomplish these multiple tasks he has to be an expert in his field.

When this squadron re-formed, many of the Staff NCOs had the dual responsibility of learning the aircraft as well as teaching their men the proper methods and procedures to use on this aircraft. Service schools, factory training and experienced teachers from adjoining squadrons were utilized to the fullest extent both for the Staff NCOs and the other personnel. NCOs from other local operating units formed the nucleus for our maintenance department. These NCOs have made "little things" obvious and through supervision, leadership and constant training, these little things are being constantly eliminated. This is evidenced by the reduction of ground mishaps. In this past year (FY-62) the number was less than *40 percent* of what it had been the year before. This

accumulated experience, wisely used to teach others good safety practices, made our personnel more aware of unsafe conditions and practices and lead to a safety conscious attitude.

The Staff NCOs within this unit have converted the safety program from a chore into a crusade. They have provided the inspiration necessary so that this program will not lose its force. They know what is expected of them and in turn the personnel within their shops know what their responsibilities and duties are. There is only one way to do any task, the right way in accordance with squadron procedures.

The longest section of our chain includes people below the rank of Staff NCO. It is quite obvious that this is the section where we can expect the weakest links and I am sure we all have a few inexperienced persons in every squadron that are at least borderline cases. It is the responsibility of our officers and Staff NCOs to find this weak link and assist him by training and close supervision or expel him.

Where did we start? We have said this philosophy starts at the top and flows down by leadership and force. A clear philosophy of *safety* is the fountainhead of all our accident prevention endeavors. No complicated document couched in legal phraseology but a concise statement of the organization's concept of safety, a definition of areas of responsibility and a classification of safety goals.

Our personnel are aware of this philosophy and they realize it is the only channel which will be utilized. This attitude was not attained overnight and I do not think there is any shortcut to reach this goal. Just as Rome was not built in a day, the accident-free combat ready squadron cannot be achieved in a day—if it is to last and survive we must begin with a firm foundation.

How do we achieve this firm foundation? Training and more training—a safe/combat ready squadron must have capable, competent, trained personnel. Personnel are taught to think safety and act safety on their own. This is not as hard as it may seem. Psychologists teach that good habits and practices are just as easy to build as bad ones, and that all of them are easier to make than break. It is these good habits that we impress upon our people. The habit of using the book (HMI, Maintenance Instructions, etc.,) is instilled in each individual. Especially those "old salts" that have done this job dozens of times before—this is where we run into those little things that are overlooked or incorrectly installed.

Our personnel must consider every detail of every job, they must give attention to the quantity and type of tools, quantity and type of equipment; the technical directives governing the job and a close look into all their elements.

In a well trained individual or group we find that pride has entered the picture. It is our responsibility to keep the idea of his job and pride in his job paramount. Praise a man when he does well, and show an interest in his accomplishments. This individual pride soon becomes esprit de corps and we have molded this individual into an integral part of the team, a safe, combat ready squadron.

and top quality maintenance

produce an effective combat team.

An Ounce of Prevention

By LCDR M. B. Nichol

Over the years, this has probably been one of the most well-known slogans. Regardless of age and use, it is still appropriate especially in flying safety circles.

As the Hangar Maintenance Officer of a West Coast squadron, this slogan paid off for me as it no doubt has for others. We all know the difficulties that can be encountered in presenting an on-the-job training program; that is to insure effectiveness and be convincing all in one hour a week.

All of the division officers had been struggling to keep the program going strong when a transient pilot came strolling into the maintenance office. He had just arrived to attend a conference and wanted to know if we could look over his sick bird. It seems that on takeoff at his home field his EGT and RPM had both been a little on the high side.

An inspection turned up a possible overheated area. The next chain of events followed a familiar pattern—off came the tail and a more extensive check of the engine and engine instruments was made. The engine inspection indicated overheating had occurred and the cause was also discovered. When the tailpipe temperature gage was bench-checked it was found to be reading 60° low, so that the aircraft indications that had been reading "a little high" were, in actuality, 60°-80° over maximum operating limitations!

As the engine had been damaged to some extent, there were some AOCP parts, including a turbine wheel, that caused the aircraft to remain longer than expected. The pilot was naturally interested and showed considerable concern. Initially he expressed disbelief until he was confronted with overwhelming evidence. Then he wanted all the information to take back to his squadron. All of this information was gathered and mailed to his squadron maintenance officer.

While awaiting parts for the engine, the Martin-Baker seat on this aircraft became due for inspection. About 15 minutes after the crew had started their inspection, the CPO from the seat shop asked me to come over and see the condition of the seat. Initial inspection showed considerable rust on much of the mechanism. The flaps covering the drogue chute were dry-rotted so badly they were practically in shreds. I told the Chief to go ahead but I wanted a written report on exactly what he found, step by step. After getting the drogue chutes back from being repacked the list had reached a total of 27 discrepancies ranging from very minor to major. A couple were important enough in the opinion of the seat crew that there was less than a 50-50 chance of the seat firing. If it had fired, the chute would not have opened automatically and the pilot would have experienced considerable difficulty in separating from the seat manually.

These facts, in conjunction with a 60° gage error in the engine instruments, added up to a staggering total.

Pity the poor pilot flying this aircraft. However, our maintenance department reaped a tremendous harvest at his possible expense. All of our training programs received a big shot in the arm. When the engine Chief said, "This is a lot like that plane we just worked on" or anything to jog the mechanics' memories of their recent experience, they listened, they paid attention and they learned. The seat shop Chief had a similar experience. His people had had the chance to see poor maintenance in action. The importance of their job and its direct relationship to pilot survival had been stressed to them a thousand times. Nothing can be so graphic as an actual example and the follow-up of the possible consequences.

The squadron responsible for maintaining this aircraft had a lot of airplanes, three or more different models among them. The subject aircraft had been in the fleet for some time and all the bugs were out of it. It was easy to maintain—fill it with jet fuel, give it a quick preflight and it was ready to go. All of these things were "known" about this aircraft.

The other models being maintained by the squadron were not this way at all—new, complex, with a lot of operational commitments. Worst of all, there never were enough trained men to keep them ready to fly—certainly not enough men to spare very many of them on the old model aircraft. *It would take care of itself.* Certainly, this is overstating the case, but the tendency is there, and this tendency can grow into neglect.

Work must be done at all levels. It must be coordinated with a training program to insure the highest degree of training possible.

A concentrated effort must be made at all times. Complacency is an evil that cannot be tolerated in this age of high-performance aircraft systems.

Stated simply, safety and efficiency are the product of a well-informed, well-trained organization.

Naval Aviation in the Years Ahead

by Fitzhugh Lee, Vice Admiral, U. S. Navy

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Human nature has not changed much throughout recorded history. We must assume that we may not be able to wage peace with complete success in this decade and that power-hungry men and systems will still be abroad on earth in 1973. As prudent men, we must make plans to deal with whatever may come. Such plans must consider the other fellow's intentions and capabilities, and how best to outfox him.

In short, in 1973 we must still be ready for war. To gain an idea of what form such a war might take, let us look at the situation today and then try to forecast probable changes during the coming decade. Let us try to predict what these changes portend for naval aviation. This is no easy task.

It took thousands of years for our ancestors to invent the wheel and thousands more before man could travel faster than a horse; now, astronauts are traveling at 18,000 miles per hour. We have seen air travel become commonplace. We have developed radar, television, nuclear power, jet propulsion, guided missiles, and a whole new world of plastics and medicines. The concentrated light beams of lasers signal another quantum leap in technology.

The extraordinary development of naval aviation in our time, makes us realize how difficult it was at the beginning of each decade to foretell what even the next few years might bring. Some forecasters predicted but a short life for naval aviation; most predicted progress, but they underestimated its rate and acceleration.

Who, in 1943, could have foreseen that a naval officer in the B-29, "Enola Gay" would be the weaponeer to drop the first atom bomb and signal the end of history's greatest war? Who would have dreamed that by war's end 110 U. S. and allied aircraft carriers would have taken part, and that, despite the gloomy views of those who called them "sitting ducks," only one would have been lost through land-based air attack?

Who, in 1943, could have predicted that carriers would sustain lower loss rates in war than battleships, cruisers, destroyers, or submarines; that in the war in the Pacific several times more enemy aircraft would be destroyed per carrier-based aircraft than per shore-based plane, and that at war's end the Navy would have 40,000 aircraft and almost 50,000 naval aviators to man them?

Who, in 1943, could have foreseen that in 1946 a new age would start when an FD-1 (later FH-1) Phantom jet fighter took off from and landed aboard USS FRANKLIN D. ROOSEVELT (CVA-42), that by 1950, a carrier bomber would take off from USS

CORAL SEA (CVA-43) with an atomic bomb in its belly?

At the start of 1953, no one foresaw that in 1959 a *Jupiter* rocket would streak 1500 miles across the South Atlantic with Alpha and Baker, two squirrel monkeys, in its nose cone. This was the first round trip through space to be made by any living creature. Both monkeys were trained and equipped for their space journey by the U. S. Naval School of Aviation Medicine, Pensacola, Florida, and monkey Baker is still alive and kept at the school. Her apogee of 350 miles still stands as the world's record for the highest altitude attained by a living creature. Her historic flight signaled man's assault on space. In that assault, a naval aviator, LCDR Alan B. Shepard, Jr., was the first American to venture into space, and a Marine Corps aviator, LCOL John H. Glenn, Jr., was the first American to make an orbit around the earth.

Now, in January 1963, who can tell what the next 10 years will add to world history: what kind of peace? What kind of war? What kind of aviation? Crystal balls in the past were fuzzy and fallible. The only thing we can be sure of is change—change, and the realization that some things change faster than others.

During the next decade, physical geography will not change much. In 1973, land will remain only a small part of the earth's surface. The immutable seas will still exist, their depths still largely unexplored. The atmosphere will continue to bathe our earth. The vast reaches of space will offer unlimited unknowns to the probes of puny man.

We live, in 1963, in an uneasy world which is changing rapidly. It is a world divided in which two power galaxies are locked in struggle—one trying aggressively to enslave the world, the other trying defensively to preserve freedom and to extend it to all mankind. Each galaxy possesses the military power with which to destroy the other. The Free World does not want to use this power. The Communist world fears to use it, lest at the same time it destroy itself. We call the Communist answer to this dilemma the Cold War. It is a total war, involving every technique of propaganda and action with each move designed to win control over both minds and bodies. It is a war of subversions, of nibblings, of infiltrations, of probings, of toes over chalk lines—chalk lines as close as Cuba.

The Cold War started with the Bolshevik Revolution of 1917, the year when U. S. naval aviators first flew in combat. World War I, World War II and the Korean War have since been fought. Now, in 1963, who is on top? On whose side is time? There is no clear-cut answer; a case can be made for either side.

In such a setting of world struggle, freedom's military forces have a difficult role. Unquestionably, we must maintain an effective deterrent to a nuclear exchange; this costs a tremendous amount of money. At the same time, to cope with continuing cold and warm war short of the nuclear exchange, freedom's military power must be flexible and mobile. It must be able to adapt to each situation the aggressor poses with precise gradations of power, precisely applied at the right time. It must be able to muster power quickly at any one location or simultaneously at several scenes the enemy selects. It must be able to sustain this power indefinitely even though the logistic cost be enormous.

In 1963, the deterrent is maintained by the threat of a counter-blitz delivered by almost unbelievably

powerful striking forces. These deterrent forces include a growing, atomic missile power, both land- and sub-sea-based. These forces are supplemented by U. S. and British strategic bombers, by carrier-based strike planes, and by land-based fighter bombers of the U. S. Air Force, the U. S. Marines and our allies. The deterrent is reinforced by the existence, at the ready, on-station, of Free World land forces, which, using atomic weapons if needed, can oppose Communist land forces should they burst from behind the Iron Curtain.

We fervently hope that this massive and costly deterrent is successful. Even if it is, the Free World also must be able to cope with Communist military actions short of the atomic blitz. These actions we call "limited war"—limited in objectives, limited by such considerations as the size of the theatre of conflict and its location, and limited by the type of weapons used (no first use of atomic weapons).

The forces for such limited wars are, in current Pentagon vernacular, known as general purpose forces. Particularly, in the decades since World War I, naval forces have shown themselves to be eminently suitable as general purpose forces. Based on the open sea, naval forces can apply graduated power with the least friction in the widest variety of situations. The landing in Lebanon and the quarantine of Cuba are good examples of such power application.

In 1963, our naval general purpose forces fall into five principal categories: carrier striking forces, Polaris striking forces, amphibious forces, antisubmarine forces and logistic forces. Two characteristics are significant. First, all of these forces can contribute to our success in an atomic blitz and/or to its decisive aftermath. Second, in all of them except the Polaris forces, the manned airplane plays an important role ranging from the dominant to the merely significant. There is little ahead to indicate that these two characteristics will be changed in 1973.

7 3

First, manned naval aircraft will be busier than ever in 1973. There will be large numbers of earth satellites in orbit, some belonging to the Free World and some to the Communists, which will be able to perform reconnaissance missions over all the ocean areas of the world. This is of signal import, for the long history of war at sea has been marked by prodigious search efforts to find out what was where on the surface of the sea, and it has been marked also by countless hours of worry because one side didn't know what the other side was doing in vast areas of blue waters.

The reconnaissance satellite may reduce this knowledge radically, but it will not tell whether its discoveries are friends, foes, or neutrals. Hence, it will be necessary to identify the targets announced by satellites and destroy them promptly if required. Obviously, the airplane—the manned, 1973 airplane—is going to have a much busier job than heretofore in the investigation of contacts reported by satellites over the important ocean areas of the world.

Second, in the coming decade there will be a growing realization that the principal military force most certain to survive a nuclear exchange will be the naval force at sea; the bases ashore will be the sitting ducks. This realization will tend to emphasize the importance of naval forces as command and control centers, as the indestructible part of the nuclear deterrent, and as the means by which we can regroup our forces when the blitz is over and we are faced with the job of deciding who then wins the war. Naval aircraft will be an invaluable part of these surviving forces.

Third, in the decade ahead the Russians will develop a substantial "Polaris" force of their own. Freedom's side will have to make enormous efforts to contain such a force, to ascertain its presence and movement, and to be able to counteract this part of any Russian blitz. The need for an improved ASW capability in 1973 is apparent. Naval aircraft clearly will continue to provide a vital contribution to such a capability.

Fourth, the need for increased attention to ASW will become more evident also as we realize that the survivors of a nuclear exchange may include a large number of Russian submarines, at sea before its commencement. They will survive the counter-blitz and will seek to strangle our operations at sea in the decisive phases of the war which follow. Again, naval aircraft would be important to the blocking of this sort of strangle hold.

Fifth, there will be a reinforced awareness that wars will not be decided so much in aero-space as on the land and over, under, and on the seas of our earth. The space vehicle will not render the naval aircraft obsolete.

Sixth, the growing pains of a multitude of new, underdeveloped nations will cause local conflicts in many areas of the world, and provide advantageous locales for Communist attempts to increase the area of Communist control. Freedom's job will be to thwart such ventures. Naval power and naval air power will be required.

Seventh, the skyrocketing costs of military forces will dictate that increased emphasis be placed on those forces which are most economical because they are versatile. The economical forces will be those

which can contribute to the deterrent, which can survive the first blitz in order to contribute to the counterblitz and which can also serve with distinction in the various forms of limited war. Certainly the importance of naval air forces will loom large in any such assessment.

Eighth, in 1973 our weapons systems, including our naval aviation systems, will be even more complex than those of today. This is an unhappy thought. for complexity is today's millstone. Significantly the man on the ground, under the sea, and in the air will not become obsolete; he will be more important than ever before. Push-button warfare, if it comes, will place tremendous responsibilities on men to make the machines work when the buttons are pushed and great emphasis on the training of the minds of those men whose fingers must push the right buttons at the right time.

The coming decade will see an increase in guided missiles, as they replace some manned interceptors and some strategic bombers. Command of the air will continue to be a requisite for successful warfare. In some situations, this command can be attained only by manned aircraft, so that thought, judgment and common sense can be brought to bear on the problem. The nation that fails to appreciate the unique advantages and potential of manned aircraft, particularly in ASW, and that neglects them in favor of missiles will deny herself a highly versatile capability.

Mindful of all these things, American naval strategists have been going forward with plans for the Navy of the 1970s. Approved plans of our government, projected ahead as far as 1968, contemplate construction of new carriers with a life-span of at least 20 years. Barring major breakthroughs now unforeseeable, it seems probable that the aircraft carrier will with manned aircraft be plying the seas in the 21st century. All of our ASW hunter-killer carriers are of the aging ESSEX *class*. We must start soon to lay down new carriers designed and built for hunter-killer operations.

Current emphasis on the rapid development of the short-take-off-and-landing (STOL) airplane will undoubtedly lead to deployment of this type of plane aboard all types of carriers, including the amphibious assault ships, and many other ships as well. The STOL airplane, however, probably will not supplant the marvelous helicopter, which can play a variety of roles in the ASW and amphibious operations of any future war. Emphasis on the use of helicopters will continue. They will be used on merchant ships for detecting and destroying submarines, and they will develop rapidly in the role of workhorses in replenishment-at-sea operations.

The ASW patrol plane will be equally important, and the successors to the P3 (P3V) *Orion* and the P5 (P5M) *Marlin* will be in production. The patrol seaplane—the development of which was handicapped by lack of funds when the P6M *Seamaster* burst the bounds of the naval budget—will continue to be useful in many roles. Seaplanes, designed for continuous operation close to the surface to take advantage of the ground effect on lift, will have great potential for long-range surveillance and for high-speed, economical, transocean transport. Above all, seaplanes are not dependent upon airports in friendly hands in order to operate effectively.

In 1973 the United States will continue to be a key member of a Free World oceanic confederation. Communism will not have been vanquished, nor will it have been killed by its own debilities. The members of the Free World confederation will be dependent more than ever on the seas and upon surface shipping for economic prosperity in peace and for mutual security in war. Control of the sea will remain dependent on controlling its surface as well as its depths and the skies above it. Control of the sea after a nuclear exchange will be particularly important; manned aircraft will play a major role in exerting such control. Our military capability for exerting control at sea must include sea-based weapons systems, including aircraft, not only to protect our own shipping, but also to defend our own coast and friendly shores on both sides of the oceans, and to allow us to project our military power to other continents.

Naval aviation has a growing potential, and the aircraft and the ships it uses surely will change in the decade ahead. All this will be true unless, as we all hope, man himself can change and build a lasting peace. ●

"The first hard (photographic) evidence that Russia was sending nuclear-capable weapons to Cuba came not from the U-2's but from U. S. Navy carrier planes flying on 'routine exercises' in the Caribbean, taking low-level looks at ships inbound to Cuba."—*Strike in the West, by James Daniel and John G. Hubbell, published by Holt, Rinehart and Winston, Inc.*

What's your Angle?

by LT. G.W. Lubbers

In the so called good old days of the scarf and goggles all you needed to get into the air were two wings, a prop, and an airspeed indicator. Ever since scientists and engineers figured out why Orville and Wilbur could make like birds a primary instrument for flight was the airspeed indicator. This instrument seemed to satisfy engineers and aeronauts for several generations but with the coming of the jet age and such new terms as mach and compressibility it became readily apparent that the old standby had several undesirable limitations. So it was back to the drawing boards and conference table. What evolved was a unique device to measure aircraft pitch with respect to the relative wind. This was subsequently labeled the Angle of Attack Indicator.

Since its introduction to the fleet in the mid-1950s, the system has been collecting a large following of ardent carrier aviators. The instrument has steadily progressed in both technical design and professional usage and has probably generated more arguments at "Happy Hour" than a fighter pilot in a group of attackers. Several articles have been published endeavoring to explain various aspects of the angle of attack system but there still exists a certain amount of confusion about some of the instrument's functions.

The instrument works on the same principle as the old weather cock on a barn roof. A probe or vane is mounted in the windstream and always remains cocked into the relative wind. This vane is mechanically and electrically tied in with various servos and potentiometers to give the indications of angle of attack. One fallacy of the system is that the angle measured is not the angle of the wing chord line with the relative wind but that of the fuselage reference line with the relative wind. However, this is easily compensated for and presents no major problem in most aircraft.

To thoroughly understand how and why the system works is to thoroughly understand basic aerodynamics. I'm sure you all remember lessons in physics on the properties of fluids and Bernoulli's principle so we don't need to go that basic. Let's start with a symmetrical airfoil moving through a mass of air. As the flow divides and proceeds around the airfoil, the increases in local velocities produce a decrease in static pressure. This can be seen in Figure IA.

As long as the airfoil is symmetrical and the chord line remains parallel to the flow of air there will be no difference in the air flow, hence no difference in pressure between the top and bottom of the section. Since there is no pressure difference there will be no lift generated by the airfoil. To generate life we must either change the shape of the airfoil and/or change

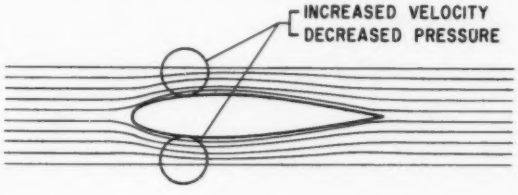


Figure 1a

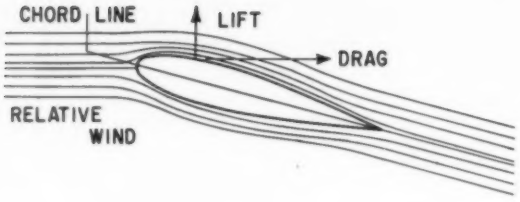


Figure 1b

the angle of the chord line to the airflow. When this is done, as depicted in Figure 1B, the point of stagnation is moved lower on the leading edge and the airflow over the top of the airfoil is relatively faster and under less pressure than air flowing over the bottom of the airfoil. This difference in pressure produces a force known as LIFT and is vectored perpendicular to the relative wind.

Three airfoil teminology definitions are in order at this point so we may derive several important aerodynamic force equations. Lift, as previously defined, is the net force produced perpendicular to the relative wind. Drag is the net force incurred by an airfoil and acts parallel and in the same direction as the relative wind. Angle of attack is the angle between the chord line of the wing and the relative wind.

Any aerodynamic force can be represented as the product of three major factors, the surface area of the object, the dynamic pressure of the airstream and the coefficient or index of force determined by the relative pressure distribution. Lift and drag may be expressed by the equations $L=C_Lq\mathcal{S}$ and $D=C_Dq\mathcal{S}$ where:

L or D = Aerodynamic force, lbs
C_L or C_D = Coefficient or aerodynamic force
q = Dynamic pressure
$= \frac{\sigma V^2}{295}$ (V being knots TAS and σ being density ratio. 1 / 295 is a constant which allows use of knots as true velocity and the altitude density ratio σ .)
S = Surface Area, sq. ft.

From the foregoing equations we can derive $C_L = \frac{L}{qS}$ and $C_D = \frac{D}{qS}$. All the aerodynamic forces of lift and drag are studied on the coefficient basis.

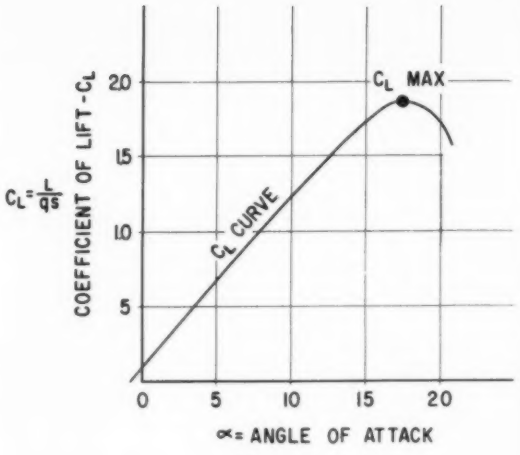


Figure 2

If the coefficient of lift for a typical aircraft wing were plotted versus angle of attack we would get a curve similar to Figure 2.

Each angle of attack produces a particular lift coefficient since the angle of attack is the controlling factor in the pressure distribution. Lift coefficient increases with angle of attack up to the maximum lift coefficient, ($C_{L_{max}}$), and as angle of attack increases beyond this point airflow is unable to adhere to the upper surface of the wing, causing separation and stall.

Several interesting items can be derived from a study of these curves. One important fact is that the aircraft stalls at the same angle of attack regardless of weight, dynamic pressure, bank angle, etc. Naturally, the stall speed will vary with the variance of any of these factors since the basic lift formula must still remain balanced.

This can be more readily shown by taking a short mathematical side trip. Taking the basic lift equation $L=C_Lq\mathcal{S}$, we can substitute $\frac{\sigma V^2}{295}$ for dynamic pressure and solving for V we get $V=17.2\sqrt{\frac{L}{C_L\sigma\mathcal{S}}}$. Since the stall speed is the minimum speed which is necessary to sustain flight, the lift coefficient must be the maximum $C_{L_{max}}$ at V_s.

As an example, let's take a hypothetical airplane with gross weight of 12,500 lbs., wing area of 350 sq.

ft., and $C_{L_{max}}$ of 1.0 for this particular aircraft configuration. If this airplane were flown at sea level in level flight (lift=weight) the stall speed would be:

$$V_s = 17.2\sqrt{\frac{L}{C_{L\,MAX}\,\sigma\,S}}$$

$$= 17.2\sqrt{\frac{12{,}500}{(1.0)(1)(350)}}$$

$$= 104 \text{ kts}$$

For this particular altitude and gross weight 104 knots is needed to produce 12,500 lbs of lift. As either altitude or gross weight increase, the airspeed must increase and as altitude or gross weight decrease the minimum speed required to produce maximum C_L will decrease. If the aircraft were placed in a turn the requirement for airspeed would go up. The one common factor in each of these conditions is that angle of attack still remains the same at $C_{L_{max}}$.

Since Figure 2 is a relationship of the coefficient of lift and angle of attack we can use it and the formula $V = 17.2\sqrt{\frac{L}{C_L\,\sigma S}}$ to find the airspeed correspondent to any angle of attack for any given gross weight and density ratio or, by transposing the formula to $C_L = 295\,\frac{L}{V^2\sigma S}$ we can find the angle of attack which corresponds to any given airspeed.

It becomes readily apparent then, that airspeed is controlled by the angle of attack which is what the LSO has been preaching all along.

As long as we're dabbling in basic aerodynamics let's take a quick and dirty look at drag. Since drag is another expression of forces acting on the airfoil it can be expressed as the coefficient, $C_D = \frac{D}{qS}$ and can be plotted graphically with angle of attack to produce a basic drag curve. (Figure 3) At low angles of attack the drag coefficient is low and small changes in angle of attack produce only small changes in C_D. At high angles of attack the drag coefficient is high and small changes in AOA produce considerably large changes in C_D.

One more interesting thing occurs when we plot a ratio of lift to drag (Figure 4). From this curve we can determine the angle of attack which will give the best L/D ratio. This angle is quite helpful as it is the angle which produces maximum endurance for jets, maximum range for props, best climb angle and optimum power off glide angle for both.

A hard to swallow fact about the gliding performance is the effect of gross weight on glide range. Since

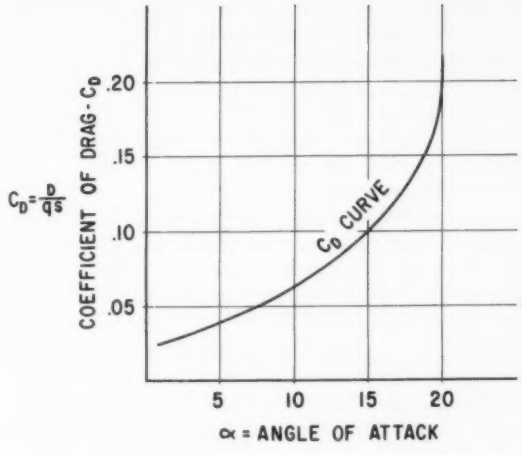


Figure 3

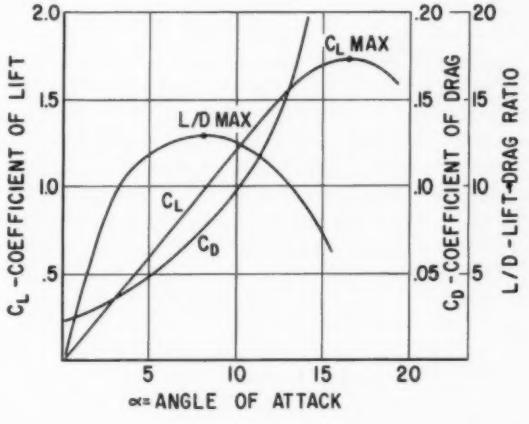
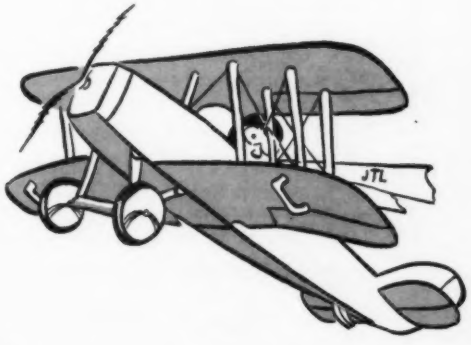


Figure 4



the maximum lift/drag ratio of a given airplane is an intrinsic property of the aerodynamic configuration, the gross weight will not effect the gliding performance. If $(L/D)_{max}$ for your aircraft is 13 you will glide 13 miles horizontally for each mile of altitude regardless of gross weight. True, your gross weight will effect the speed at which you glide but not the glide ratio or angle of attack.

So far we have only been talking about the aerodynamic characteristics of the basic airfoil and an aircraft in a clean flight condition. Now let's see what happens when we start using flaps, slats, and other forms of high lift devices.

The primary purpose of these devices is to increase the $C_{L_{max}}$ and reduce the stall speed thus reducing takeoff and landing speeds and the necessity for longer runways and stronger catapults and arresting gear. Each high lift device effects $C_{L_{max}}$ in its own particular manner but a general rule-of-thumb can be stated, "Flaps, or trailing edge devices, increase basic $C_{L_{max}}$ at a decreased angle of attack while slats, slots, or devices designed to improve the flow of air over the wing increase basic $C_{L_{max}}$ at an increased angle of attack. (See Figure 5)

The extension of flaps has the affect of adding a large amount of camber well aft on the chord line or, in theory, changing the angle of the chord line to the relative wind. The principle effect of the extension of flaps is the reduction of AOA for any given lift coefficient. There are many types of flaps, each with its own particular affects on lift, drag, and angle of attack. Split flaps for instance, as used on the A-4 (A4D) produce only a slightly larger change in $C_{L_{max}}$ than the plain flap but produces a much greater amount of drag. This excess drag is advantageous since it allows a higher power setting to be used thus decreasing engine acceleration time for waveoffs and bolters.

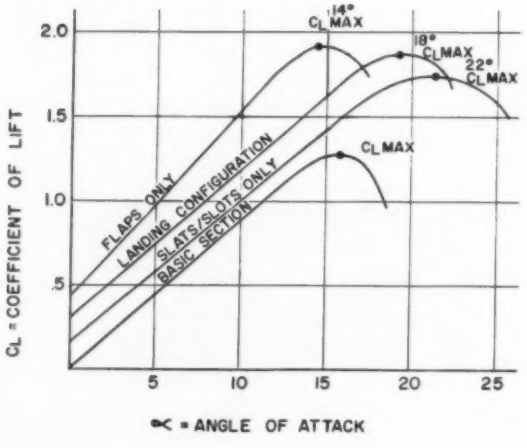


Figure 5

Leading edge high lift devices consist of slots, slats, and local leading edge camber. These devices work on the principle of varying the normal flow of the upper surface boundary layer to delay separation to a higher angle of attack. These devices have very little affect on camber and are about the only type of high lift device suitable for tailless aircraft.

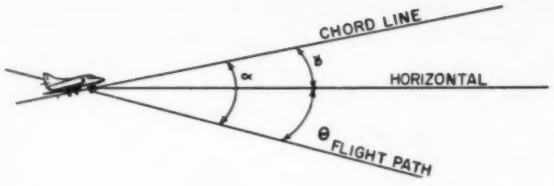
Boundary layer control is another method of affecting the air flow over the upper surface. One method of removing the low energy air is the application of suction through small ports on the wings surface. Another method which is more widely used is to bleed off high velocity engine compressor air through these wing ports to speed up the flow of boundary layer air.

Since any form of boundary layer control tends to increase angle of attack in order to increase lift it is necessary or advisable to use flaps in conjunction with these devices to decrease this tendency.

Due to each type of aircraft having its own peculiar arrangement of flaps, leading edge device, and boundary layer control, each aircraft will have its own particular set of flight characteristic curves with respect to angle of attack. Most aircraft flight manuals do not contain these curves; however, they may be obtained from the manufacturer.

Since angle of attack measurements are taken from a vane mounted on the fuselage the instrument is actually measuring fuselage reference line angle and not wing chord line angle. Therefore it is an unwise practice to assume any standard landing angle of attack will provide the optimum angle of attack for a landing despite configuration. This is especially true in the F-8 (F8U) with the variable incidence wing.

To make a successful landing you must coordinate the movement of your aircraft so that certain variables are confined within their critical limits at touchdown. Some of these variables related to angle of attack are pitch attitude, airspeed, sink rate, flight path angle, stall margin and controllability. During the approach phase of the landing you are only concerned with maintaining an angle of attack that will provide a comfortable stall margin and good controllability. However, consideration must be given to the pitch attitude and airspeed limitation necessary to keep from skagging or bouncing off the nose wheel and running off the end of the runway or snapping the



PITCH ∠=AOA - FLIGHT PATH ∠
$\gamma = \alpha - \theta$

Figure 6

purchase cable.

Figures 5 and 6 show the angle of attack curves and basic geometry of a hypothetical aircraft. For this aircraft, let's assume that the normal pitch attitude in the landing configuration is 15° and the limits are ± 2°. If we use the meatball to control the flight path angle this then becomes a constant, which we will assume to be 3°. From Figure 5 we can see that $C_{L_{max}}$ for the landing configuration occurs at 18° so plugging these figures into the geometric equation $\gamma = \alpha - \theta$ we see that landing under these circumstances can be made successfully.

Now what happens in an abnormal situation? Assume things have turned to worms and the only high lift device left is flaps. From the graph we see $C_{L_{max}}$ for flaps only is 14°, thence solving the geometrical equation will give us a pitch angle of 11° which is out of limits and if carried to touchdown would most likely result in a collapsed nose gear. It now becomes apparent that we must either change the flight path angle or the angle of attack and since the angle of attack is pilot-controlled this seems to be the easier way out. Assuming we do not change the flight path angle the least angle of attack that will satisfy pitch angle requirements is 16°, which is higher than the angle of attack for $C_{L_{max}}$ flaps and will reduce the stall margin. (Keep this in mind when correcting for a high ball and don't suck off a bunch of power.) On the other hand, with slats/slots as the only high lift device, 22° angle of attack minus 3° flight path angle puts us out of limits on the high side and a tailpipe crunch would result. To bring the pitch angle within tolerance we need to fly at 20° angle of attack which will mean a few undesired knots, crossing the ramp.

The point to remember is the angle of attack indexer and the donut are set to give approach indications based on the normal landing configuration. Any deviation from this configuration cannot be automatically compensated for by the system and reliance on the donut under such circumstances may prove to be dangerous. This does not mean that angle of attack has to be ignored in these cases, it's still a valuable instrument and will give you a more responsive indication of aircraft behavior than the pressure gages. To use it successfully—you have to—*Know Your Angle.* ●

Flare Not

During a discussion of landing phase accidents it was pointed out and agreed that many pilots of high performance jet aircraft are not making full use of two very important landing aids; namely, the Mirror and the Angle of Attack Indicator. This fact is substantiated by many of the landing phase accidents recently experienced. . . . In addition to those landings which have resulted in accidents, improper speed control and flared landing technique has been observed being used by pilots during normal weekend drills.

To eliminate landing phase accidents due to pilot technique, VF/VA flight training officers must ensure that each squadron jet pilot understands and executes mirror approaches. Each landing is a precision maneuver which requires the use of the angle of attack indicator and mirror or POMOLA. When this equipment is not available, an identical pattern must be used to a predetermined point of landing. It is just as important for an Operations Department to ensure that the mirror is in proper working order as it is for the Maintenance Department to ensure that the angle of attack indicator is maintained properly.—*NAResTraCom*

SHIPWRECK PARTY

THE boys were sitting around their leaky readyroom as the Pacific rains were washing down the A-4s (A4Ds) and the weather guessers weren't bothering to take any more observations after losing sight of the tetrahedron (1/16 mile away) in rain and fog. This was a fine day to have a little survival ground school and the Aviation Safety Officer put the arm on a "volunteer" to go pick up a parachute with seat pad and highspeed pack attached.

Unfortunately, the Safety Officer had previously proclaimed his intentions and the boys had rigged a "special" parachute w/attachments for the occasion. The "volunteer" dutifully slogged out into the wet to fetch same while the ASO gloated over his captive audience.

ANYMOUSE

In due time the ASO's assistant returned with the parachute and the intrepid duo mounted the podium. When the ASO began his pitch the first ominous warning appeared as the eager beaver assistant pulled the ripcord. The drogue chute clunked the embarrassed ASO on the side of the head and loud cheers were heard from the audience.

In attempting to extricate himself from the drogue the ASO managed to wrap himself and his loyal assistant in the 28-foot canopy. Four legs became tangled amongst the shroud lines and the dauntless two fell to the ground in a welter of flailing arms, legs, shroud lines, canopy, pleadings and weepings. Roars of approval came from the audience.

The ensuing untanglement required the simulated elapsed time for our hardy assistant to descend from a 20,000-foot ejection altitude. "Prepare for a water landing," shouted the ASO, determined to redeem some of his on-the-job training. A swimming pool caused by the leaky roof of the readyroom made this phase very realistic.

Following prescribed procedure the now dog-eared assistant released his D-ring from the torso harness, snapped his high speed pack to his right fastener while releasing his left leg quick-disconnect. The ASO bellowed "Splash!" and the fun began.

The zipper on the high speed pack was broken, requiring a pair of pliers to open it in order to free the raft from the container. There was a slight delay in locating a pair of pliers since the ASO couldn't find the key to his accident investigation kit. A quick dash to the metal shop remedied this.

With the raft in the shallow end of the pool, right at the Skipper's feet as a matter of fact, since this was the driest place in the readyroom, the eager young aviator pulled the inflation bottle. It didn't work.

Glassy-eyed, the ASO spied the inspection tag and ye gads—last inspection October 1959! He might have been able to fumble it into

his pocket except that the Skipper's curiosity was aroused and he had to hand it over amid chortling from the back rows.

Just one thing to do, get the trusty oral inflation tube out and blow the "#$%—&8*@@¢ thing up! After 15 minutes of blowing alternating between the ASO and his assistant, the shape of a PK-2 became discernable floating around in the readyroom. The two stars of the show were blue in the face, gasping for breath and completely exhausted.

This was cause for the Flight Surgeon to jump to the podium and launch a 15-minute dissertation on the evils of smoking, drinking, gambling, lack of exercise, old age and loose living. For once the ASO was at a loss for words, mostly because he was too pooped to do any more than nod his head in agreement.

Finally the ASO and his assistant got their breath back and resumed their teaching. After much struggling, pulling and groping they extracted the PRC-17 from the container, managing in the process to tear its plastic water bag cover. The ASO launched merrily into a discussion of the value of this particular piece of survival equipment and then as he pulled the aerial up and attempted to call the tower—nothing. Deader than a door nail!

The unbelieving assistant took the radio, which the ASO was now holding as if it were last weeks' fish dinner, and tried another check. Attempting to raise the aerial, the holddown clamp came off in his fingers with the aerial still stowed so the assistant cast the useless piece of equipment over the side into the nearest GI can floating by. This act was greeted with howls of merriment.

Completely undaunted by this setback the ASO brought out the

flares for everyone's view. Walking to the door and igniting the day end, the embarrassed ASO watched two weak puffs of red smoke disappear amongst the rain and fog. Upon checking, this was one of a lot that was not to be used in survival kits since July 1961.

To add to these discouragements, the other water bag had a hole in the bottom and the only usable item was a cracked signal mirror which wouldn't have helped a lot on a rainy day like this one.

Shattered, the ASO silently folded the popped parachute and useless survival gear and slunk from the readyroom. Of course, his efforts were rewarded by a confession of circumstances and free beverage at the next Happy Hour.

Tug of War

WELL, for the first hour and 30 minutes, it was probably some of the finest section tactics you've ever seen. After a year of "Staff Proficiency" flying, I was just getting used to the feel of my new conquest—the A-4(A4D). We had a nice climbout, some tactical turns, parade work, some nifty rendezvous, and a descent to 25-thousand to enjoy a tail chase.

The chase commenced beautifully and this kid was hanging right in there. As we worked down to 22-thousand, we started a hard nosedown turn to the left. I could feel the aircraft enter the buffet and suddenly there was a smart jerk—which way I went I cannot say, but the result was inverted, extremely nosedown attitude.

I had heard about the slats coming down in high G turns and possible spins and thought this was my problem so, I neutralized the controls and took a look around. I quickly realized that the bird was not spinning, or in an uncontrolled flight manuever. Even quicker I realized it was not about to recover all by itself.

With boards out and throttle to idle all my frantic pushing and pulling was in vain. About this time I peeked at the altimeter—9000 feet indicated and unwinding rapidly! Right then I proceeded to make a superb decision, for a Monday that is: "At 5000 I blast out of this beauty!"

Comforted by my headwork, I attacked the stick again. Slowly but surely the nose of the beast started to come up and around 3500 I had her pretty well under control. Twenty minutes later I landed (stick extended).

To make it short, here's what actually happened. The hydraulic boost package for my controls had not been reset properly from a previous power boost test disconnect. Every lateral movement of the control stick was taking up the slack in the release cable until I finally, and unknowingly, pulled my power boost disconnect. Fortunately, I won my tug of war but I was one frightened Anymouse. ●

HEADMOUSE

Formula "S"

Dear Headmouse:

I am trying to acquire all the data available concerning fire-retardant flight suits for the next Area Safety Council Meeting. I am cognizant of your *Crossfeed* 3-61 and BACSEB 56-61.

Specifically, questions that I would like to have answered are:

1. What exactly is "Formula S"?
2. With over 1000 flight suits in the flight gear pool, how does one determine whether fireproofing has been accomplished and how many launderings suits have been given?

D. A. LOVELACE, LT, SC
AEWBarRonPac

▶ *Item 1*: Washing procedure as outlined in BACSEB 56-61. What to wash and how is as follows:

Contract prior to N383s-89218
Must be treated with fire-retardant compound per BACSEB 38-57 after regular laundry[1]

Contract N383s-89218
Launder by Formula S[2]

Contracts later than N383s-89212 but no "Formula S" in label
15 standard washings[3]

[1]Regular laundry methods, rough dry and treated with fire-retardant compound afterwards. Ironing or pressing is not recommended after fire retardant treatment.

[2]Formula S is essentially a warm water, mild suds wash.

[3]Standard washings: ordinary detergent or laundry soap, warm water. As BACSEB 56-61 points out, if the suit is very soiled, especially with grease, it should be dry-cleaned.

Item 2: For flight gear pool equipment, to keep count of the number of launderings, the following is suggested:

A length of cotton herringbone tape, with the numbers 1-15 stencilled:

1 3 5 7 9 11 13 15
2 4 6 8 10 12 14

Sew one end inside collar; cut off number as laundered.

Very resp'y,

Headmouse

Still in the Dark

Dear Headmouse:

Night MLP was just completed at an airfield in Hawaii. The LSO called the tower for transportation and the "Follow Me" truck (radio equipped) was dispatched from flight clearance.

The driver stopped short of crossing the runway and requested clearance to cross the active. It should be noted here that he was using only his parking lights in order to avoid impairment of night vision of pilots and ground personnel—more or less an unwritten SOP. After receiving clearance to cross, the driver proceeded in the general direction of the LSO platform. He did not observe any signs of lights, vehicles or personnel.

Without any advance warning he hit a pilot standing in the vicinity of a tactical radio jeep being used by "paddles." Then the truck hit the jeep. Result: One pilot in the hospital with minor injuries. One radio jeep slightly damaged and one "Follow Me" truck out of service for a week.

Several suggestions have been kicked around to improve the situation:

- Require all vehicles operating on the field to use regular headlights at all times,
- Mask or paint out the top half of headlights,
- Require such vehicles to be equipped with auxiliary lights with red or amber filters to reduce glare,
- Require clearance lights independent of the normal system.

Don't we need some standardized night lighting for all vehicles which operate on runways, taxiways and flight lines?—*Anymouse*

▶ Thanks for the suggestions, Aloha Mouse. This problem, also brought up last month, needs a satisfactory solution. Perhaps past experiments by some of you may reveal the best answers. Let's hear from you. In the meantime there are a lot of us still in the dark.

Very resp'y,

Headmouse

APH-5 Visors

Dear Headmouse:

Is anything being done about a relatively minor yet annoying problem which faces aviators on pre-sunset or pre-dawn launches, especially while carrier-based? The clear versus tinted visor in the APH-5 helmet.

I don't know how it is with other aircraft but as an RF-8A (F8U-1D) pilot I refuse to fly anywhere anytime without the visor down. This precludes the tinted visor if any part of the flight is in darkness. Possibly this attitude is influenced by an unhappy experience I had once with a canopy implosion where the visor being down without doubt saved my eyesight, but I am sure that most F-8 pilots have similar feelings in view of the many canopy failures the aircraft has had.

Is there under development a visor assembly for the APH-5 similar in action to that of the full pressure suit helmet?

In the meantime, my own solution is this—whenever the flight will span both darkness and sunlight I have the clear visor installed. I carry with me a tinted visor which has a strip of wide elastic tape attached to the projections on the sides of the visor. It is then a simple matter to slip on the tinted visor over the clear one locked down when necessary and still retain the clear visor's protection in darkness.

H. H. LOVE, JR., LCDR
VFP-62 DET 42

▶ Your procedure in an excellent interim solution. At the present time no change in the APH-5 helmet is anticipated that will correct the problem you have brought up. Your comments were forwarded to BuWeps.

Very resp'y,

Headmouse

It *Can* Be Done

Here is USS HANCOCK'S remarkable "anti-crunch" program. It effectively reduced the number of flight and hangar deck crunches and won her a well merited "Outstanding" in aircraft handling during a recent AdMat.

Prior to a deployment in 1962 and during its ORI, the HANCOCK decided to do something about the crunch rate. In early 1962, enroute to Yokosuka, all hands including the Air Group, stopped bickering and blaming each other for the crunches and came up with a program that proved very successful. The items of the program were as follows:

• We started from scratch again and held classes and discussions with the directors and plane captains in attendance and were somewhat amazed to find that the following conditions existed:

Well qualified and experienced directors had, over a period of years, drifted somewhat away from the standard signals. The signals would be basically correct, but each director had ground some of his own variations into the program.

Experienced plane captains, when thoroughly questioned, did not fully understand all the signals. Later it was found this was the case also with a majority of experienced pilots.

The correct use of the whistle was almost a forgotten art. The use of whistles was made mandatory, consistent with common sense in regard to noise level.

• The whole problem of authority was explored and we found the problem was one of *attitude*. Directors, especially in the hangar bays, felt they had a job to do and if told by flight deck control to start the planes moving, then that was exactly what happened, regardless of the existing deck conditions in their respective bays. It was impressed on all directors to *inform* and make *recommendation* to the hangar deck supervisory personnel and flight deck control when they, as directors, considered conditions unsafe to move aircraft in their respective bays. This item alone saved us crunches—numerous times aircraft movement was stopped in a particular area upon the recommendation of the director.

• All pilots were thoroughly briefed on all signals.

• All directors were given larger numbers on their yellow shirts for easy identification. Any infraction of a signal or any other unsafe practice by a director was reported by the person so observing to the Aircraft Handling Officer via written note, as soon as possible. This item cut out the bickering, got to the meat of the problem while it was still fresh in everyone's mind, and definitely furthered the education of both the directors, plane captains, and the personnel reporting the infraction.

• A concentrated program was started to insure that a maximum number of supervisory personnel were on hand during all aircraft movement and that aircraft did not move without wing walkers and chockmen. This is considered common sense, but the one big item that will be abused unless *continually* checked by supervisory personnel.

• Competition, centering around a party in WesPac, was initiated between the flight deck and hangar deck. The division having the most crunches paid for the party. Records were maintained on each director and no matter who was at fault, or the existing deck conditions, if a crunch occurred, the director in charge was so marked.

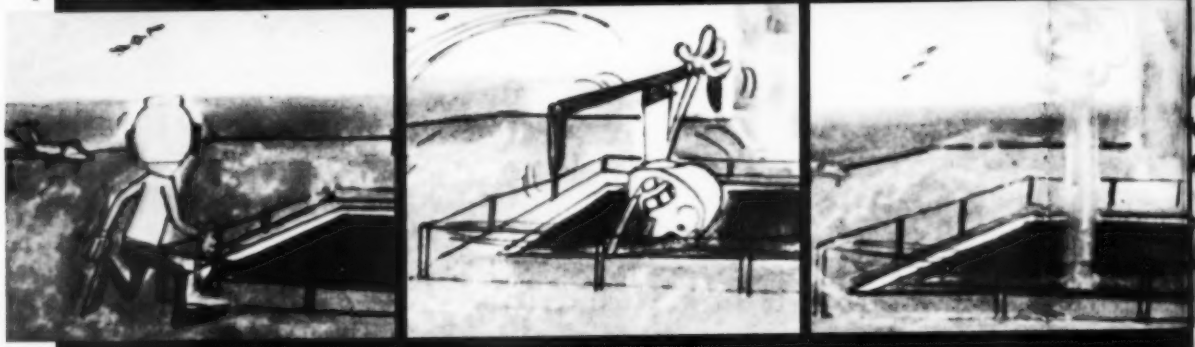
With competition, it was found that the directors *do* take definite pride in their status and accomplishments. As a group, the yellow shirts are very interested and concerned in weeding out the personnel not considered qualified directors; so discipline did enter the picture and some directors lost their status. Again we found the same few directors involved in the majority of crunches and close calls. The weeding out of unqualified or inexperienced directors is considered a *must* and can only be accomplished through close supervision of the officers and leading petty officers.

• All crunches were written in long hand by all concerned, investigated thoroughly and reviewed by the Division Officer, Aviation Safety Officer and Air Officer. All crunches were then made a subject of the next joint ship/air group safety council meeting.

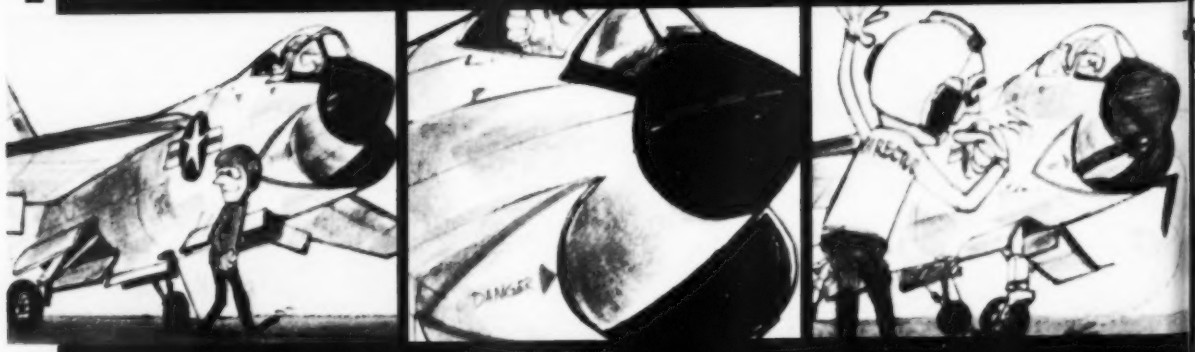
• Very close coordination was accomplished between pri-fly and the bridge during flight quarters and between the bridge and flight deck control when not at flight quarters. At flight quarters, prior to all ship's turns, the turn was passed via the MC from pri-fly. All aircraft movement ceased, all deck edge elevators remained topside and in rough weather the bridge ascertained that all aircraft were secured prior to turns. Granted, this has the tendency to delay respot, launch and recovery, but we found the delay was completely acceptable and worthwhile when you compare our crunch rate with other carriers. ●

Flight Deck Safet

1 Wear protective clothing.



2 Watch your step.



3 Beware of aircraft turning up.

4

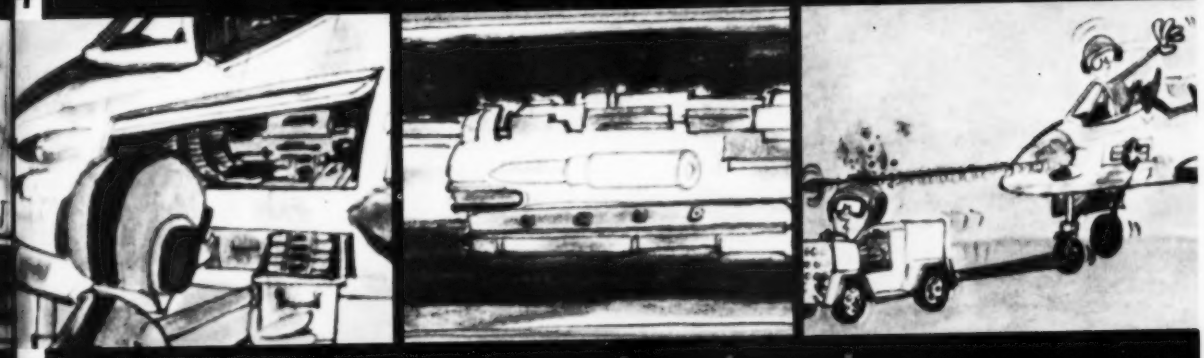
5

6

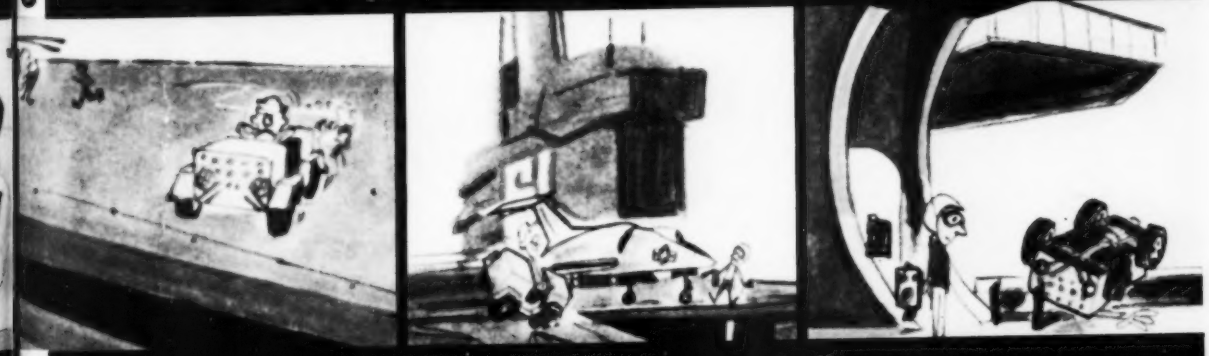
APPROACHIST

t by the Numbers

4 Don't be a spectator.



5 Obey fueling and arming rules.



6 Operafe vehicles carefully.

See Navy Training Film "Flight Deck Safety—Danger, Stacked Deck" (FN 8909)

DESTROYER

United States Navy destroyermen are as gung-ho a group of sailors as can be found anywhere on earth. They are a proud group of men and with good reason—their record of successful rescues speaks for itself.

Any destroyerman worth his salt will insist that plucking aviators from the sea is right up his alley and that a destroyer is every bit as effective in this role as a helicopter. Chopper people, of course, insist theirs is the most effective rescue system. The argument runs hot and heavy. There is one thing no one will argue about however. Both groups heartily agree that *success or failure of a rescue almost always depends on the training of the crew.*

In recent months destroyermen have done much to increase their rescue capability. Both ComCruDesPac and ComCruDesLant have issued comprehensive direc-

by Major H.G.C. Henneberger

When the call to rescue stations is piped aboard a destroyer all hands concerned with rescue operations cease normal activity and prepare for what could be a life or death situation. Such preparation cannot be taken lightly. Precious moments lost during a critical pickup while an essential piece of equipment is searched for can result in loss of the pilot's life. Rescue gear, which has been periodically checked for material condition during periods of non-activity, now is broken out and inventoried. This includes kapoc heaving lines, nylon rescue lines, swimmers' harnesses, rescue slings (horsecollar), grapnel with line attached, and such other equipment as required by local SOP.

Rescue swimmers who are now equipped with a skin diver's wet-suit exposure garment must check their suits and equipment carefully. These swimmers must be the best that are available regardless of rank or duty assignment. They in particular must have an up-to-date knowledge of aviator equipment and must be given ample opportunity to train in the water for their critical task. With a wet-suit the swimmer is no longer at such a disadvantage against the hostile sea. In addition to protection from cold water exposure the suit provides buoyancy to such a degree that no additional flotation aid is required. Finally

Preparing the deck and checking rescue gear when the pressure is off will ensure greater efficiency in action.

ER RESCUE

tives on the subject. There have been fleet-wide training efforts made to cut down the odds against rescue failures. There are few things more tragic than to have a pilot or aircrewman survive an ejection from a stricken aircraft and then be lost during the rescue at sea because of human error.

One of the most recent efforts to cast more light on the subject of aviator rescue from the destroyerman's viewpoint is a 30-minute training film in color titled "Destroyer Rescue of Aviators." The film (MN 3760C) was a joint effort by destroyermen and the U. S. Naval Aviation Safety Center. There is a limited supply of the film and it will take some time for the available copies to make the rounds. The following article amplifies some of the problems discussed in the film and provides destroyer people, carrier people and aviators with a review and reference on the subject.

the swimmer has much needed freedom of action when working with an immobile pilot—especially one whose parachute is still attached.

Watch for Distress Signals

When a pilot is down at sea there are several distress signals he employs to attract attention. Lookouts are stationed high in the ship both at night and during daylight and quiet is maintained throughout when a search is on. Destroyermen must look for the bright orange smoke from the standard Mk-13 distress signal or flashes from a survival mirror which reflects sunlight back to the ship. Not so easily seen from a distance is a bright green dye marker that the pilot spreads on the water.

At night the reflective tape on the pilot's helmet shines brilliantly from a distance when a search light reflects off it. Tracer bullets from the pilot's .38 caliber pistol can be seen for miles, or the pilot may actuate a night flare that burns with a bright red glow or send a flashing signal with his flashlight. Close in he may blow his whistle.

Once sighted, the pilot's bearing and distance is communicated to the bridge immediately and thence to CIC for a DRT plot. Lookouts do not take their eyes off the pilot for in a rough sea he can be easily lost.

Destroyermen should be familiar with the many distress signals which Navy pilots may use in the water.

Properly rigged davit with guy lines taut is essential

Proper Approach is Critical

The approach to the downed airman is, of course, made at the Captain's discretion depending on the circumstances. There are no hard and fast rules. Most destroyer skippers, however, prefer to approach upwind from the pilot for ease of control. When at the crucial point in the approach the Captain orders "all stop," he soon finds himself at the mercy of the wind and tide.

An overshoot with the pilot close aboard can bring him dangerously close to the main induction and screws. An undershoot with the pilot upwind results in the destroyer being blown away from the scene of the rescue. This can get very complicated if the tethered rescue swimmer has already gone into the water with lines attached. Needless to say, the best ship handler aboard has the conn when such delicate maneuvering is required. *(See "Quick Pickup", Nov. '58* APPROACH *for more on this aspect.—Ed)*

Avoid the Main Induction Trap

No two rescue situations are alike so destroyermen prepare to modify techniques to fit the circumstances. Because of the danger of the main induction and screws, however, it is generally agreed that rescues be made from the foc's'le—on either port or starboard side. The davit with snatchblock attached is rigged on the preferred side and ready to lower the swimmer away on orders from the Captain. Once the destroyer is in position and the order is given, the swimmer is lowered to the water in the horsecollar with a light nylon tending line attached to a harness around his waist.

Once the swimmer is in the water, another standby swimmer on deck, acting as a line tender, pays out the line or takes up slack depending on the swimmer's progress in the water. Too much line or too taut a line hinders the man swimming, who also has the task of carrying the horsecollar to the pilot.

Many swimmers prefer to jump into the water rather than being lowered in order to save time—but recently a destroyer swimmer lost his swim fins when he jumped from the foc's'le. It was only after much difficulty that he recovered the fins and effected a successful rescue. The swimmer later said that the rescue would have been all but impossible had he not recovered his fins.

Expect the Worst

Always assume that the pilot is unable to assist in his own rescue because of possible injuries, shock, or exhaustion. A pilot in the water unable to help himself or with a deployed parachute still attached to him is in a bad situation. If the parachute sinks below the surface of the water it acts as a huge sea anchor which prevents the pilot from rising and falling with wave action. With waves washing over him it doesn't take long to drown. Currents created by wave or surface craft action also can act upon the sea anchor canopy and pull the pilot under *even with his life vest inflated.*

Should the pilot's life vest not be inflated, along with a deployed parachute, he is in the worst possible straits. The sheer weight of the water-soaked parachute exhausts him in only a few minutes. Every effort must be made to reach the pilot without delay. Minutes and even seconds are precious during a critical rescue. Time lost due to unpreparedness, indecision, failure to understand the problem or faulty ship handling could prove fatal.

Swimmers Must Know Pilot Gear

Swimmers must be familiar with the various equipment worn by pilots since for each type of equipment a different rescue procedure is called for. Before being lowered into the water, swimmers should be able to make a reasonable determination of equip-

Horsecollar will not function safely when Mk-3C is worn—attach safety strap to D-ring on integrated harness.

ment worn by the pilots. Destroyer personnel expecting plane guard duty should know what the various pilots aboard the carrier are wearing prior to flight operations. *They shouldn't hesitate to use blinker to ask if they don't know.*

Most pilots who fly jet aircraft wear the integrated parachute harness with the yellow doughnut-shaped Mk-3C life preserver. Pilots flying prop aircraft usually wear the standard parachute harness with the familiar mae west life vest. Helicopter pilots normally have only the mae west on since they don't wear parachutes. The full pressure suit is worn on flights above 50,000 feet, and pilots flying the latest jets are beginning to wear this more and more. Full pressure suited pilots wear the bright orange colored Mk-4 life vest similar in shape to the mae west. *(In the summer of 1961 the Naval Aviation Safety Center distributed an audio-visual presentation to the fleet to acquaint destroyer personnel with aviator's personal equipment and harness release devices.—Ed)*

Use D-Ring With Doughnut

Swimmers must know that if a pilot is wearing the yellow doughnut-shaped Mk-3C life preserver, the horsecollar rescue sling can't be slipped under his arms because the inflated preserver fits too snugly under the armpits. If the horsecollar is slipped around below the inflated preserver, there is the danger of injuring the pilot's back when he is hoisted aboard, or if he is unable to help himself, he can fall out of the sling head first. Because of the problem of hoisting pilots wearing the integrated harness, a special D-ring on the end of a 5″ length of harness webbing has recently been added to the harness. When the safety strap attached to the horsecollar is attached to this D-ring located chest high on the right side of the harness, the pilot is safely hoisted at the davit to the foc's'le deck.

When the pilot is wearing the yellow Mk-2 mae west or the bright orange Mk-4, there is no problem fitting the horsecollar under his arms, and he is easily hoisted aboard even if he is immobile and unable to help himself—providing, of course, that the horsecollar is placed around him properly to begin with. The hook at the end of the hoist cable where the two ends of the horsecollar meet *should always be in front* of the rescuee's face. If the person is put into the horsecollar backwards, he can fall out of it during the hoist.

Fasten Line to the Pilot First

Regardless of what equipment the pilot is wearing, the first essential in any rescue situation is to make a line fast to the pilot. There are usually several other things to do but this *always* comes first. With the integrated harness, the safety strap from the horsecollar is attached to the D-ring on the harness. With the standard harness and the full pressure suit, the horsecollar is slipped under the pilot's arms. Once the line is made fast, the swimmer can then proceed with other things, depending upon the circumstances.

If the pilot's life vest is not inflated, this is done. Specific knowledge of the location of the inflation toggles on all three types of life vests is essential. Should the pilot's oxygen mask still be on, it is removed, because with the mask in place, his self-contained oxygen supply sustains him for only a short time after ejection. If he is not able to help himself, he may suffocate when his short supply runs out. If the swimmer is unable to release the oxygen mask fittings, he cuts the mask off with his webbing cutters.

The Perilous Parachute

Low altitude escape systems enabling the pilot to eject from a stricken aircraft near water level are now installed in most carrier-based jet aircraft. In a low altitude ejection, parachute openings frequently occur only seconds prior to water entry and more often than not the pilot is dazed, injured or in a state of shock and is unable to free himself from his parachute. This presents the destroyer swimmer with his most formidable rescue problem.

After making a line fast, inflating the life vest, and removing the oxygen mask, the swimmer next gets the pilot free of his parachute. If the pilot is wearing an integrated harness, the two quick-release hardware fittings on the harness just below each collar bone are actuated. Should the swimmer for any reason be unable to release the parachute by actuating the quick release hardware, he uses his webbing cutters and attempts to cut the parachute riser straps just above the shoulders. ("Pilot Rescue Facts"—NavWeps 00-80J-2 provides close up photographs of this hardware.)

No attempt should be made to cut the parachute shroud lines because this is a time-consuming and complicated process. Also every effort should be made to remain clear of parachute shroud lines while working on the pilot, for with the tending line around his waist and the line attached to the horse-collar the swimmer can easily become entangled in the mass of lines and need rescuing himself.

When the standard harness is worn by the pilot, the entire harness is removed in order to separate a deployed parachute. Ejector snap fittings at the chest and at each leg near the hip bone are released. The harness and the parachute with it should then fall free. If for any reason the rescue swimmer is unable to release the ejector snap fittings, he cuts the parachute riser straps in the same manner as with the integrated harness.

When the swimmer is confronted with a pilot wearing a full pressure suit, quick release hardware identical to that on the integrated harness is actuated. *If this fails, the riser straps are cut,* since this harness cannot be as easily removed as the standard harness.

When the pilot is free of the parachute, the swimmer gives a "thumbs-up," and destroyermen on deck haul them both alongside. The pilot is hoisted aboard followed by the swimmer.

Unable to Free Chute?

Sometimes, because of fatigue or numbness due to cold water exposure, the destroyer swimmer is unable to remove a parachute from a pilot. Then it becomes necessary to lift the pilot from the water with the parachute still attached. *But in such a situation the parachute must be pulled from the water with a grapnel before the pilot can be hoisted.* It is

First the swimmer makes a line fast to the pilot, always remaining well clear of the treacherous shroud lines.

When other methods fail, simultaneous hoist of pilot and parachute is necessary—a delicate, coordinated operation.

impossible to hoist the pilot with a parachute canopy even partially filled with water hanging to him. The grapnel is tossed from the deck so that it snags several of the shroudlines at the canopy end of the parachute. If the canopy has sunk below the surface, the grapnel man will have to fish for it, taking care to keep the grapnel clear of the pilot. The parachute is then lifted clear of the water with the grapnel and at the same time the pilot is hoisted at the davit. It must be a coordinated action. Because it is so cumbersome, this method of rescue is used only when, for whatever reason, the standard procedures have failed.

Whaleboat Techniques

Although most destroyer skippers prefer to use the destroyer itself as the rescue vessel, there are occasions where the motor whaleboat is used. A boat crew consists of a coxswain, engineer, bow hook, hospital corpsman and at least one swimmer. Two swimmers do not cause undue crowding in the boat, though some destroyers prefer to have a boat officer instead of the second swimmer. Boat crews, like swimmers, cannot be expected to function efficiently during a rescue without prior training. Boats should carry a horsecollar, webbing cutters, nylon lines, blankets and medical supplies.

When the parachute is still attached to the pilot, the boat makes its approach to the parachute and not to the pilot. Because of the element of haste, the tendency is for the boat to overshoot. Extreme care is taken to keep the parachute away from the stern because even with the engine at "all stop" the boat propeller can still be turning enough to become entangled in the shroudlines. When the boat reaches the parachute, the bow hook snags the canopy and pulls it in, making it fast to the kingpin in the bow

When the pressure is on even the best tend to overshoot and risk entangling the canopy in the screws.

so the pilot is secured to the boat and cannot be lost. As the boat first approaches the pilot, the swimmer with a line attached should go into the water to assist. If the parachute sinks below the surface before the bow hook snags it, the swimmer makes fast a line on the pilot and then attempts to free him of the parachute. One pilot was lost because the boat crew attempted to get him into the boat with the parachute attached. They had him halfway in, but because of sea anchor effect by the chute and the rocking boat action, he was pulled back into the water and drowned before he could be retrieved. When the pilot is free of the parachute, he is pulled into the boat facing inboard to prevent injury to his back coming over the gunwale.

When Helicopter is First

When a helicopter has arrived on the scene first, the helicopter pilot has the responsibility for conducting the rescue. The destroyer and whaleboat, if it is in the water, stand clear in a position to be seen by the helicopter pilot. The destroyer takes care not to block the helicopter's wind since it depends on wind for hovering flight.

Good communication between the helicopter and destroyer is often essential to successful rescue at sea, but past experience has shown that it isn't always available. Should radio communication be lost and the helicopter pilot desires that the destroyer take over the rescue for any reason, the standard method for requesting "take over" is for the helicopter to circle the survivor at 200 feet. When this occurs, it is essential that the destroyer act immediately. Time wasted here can result in loss of life. The destroyer confirms the takeover by sending "ROMEO" on flashing light to the helicopter pilot.

In certain isolated cases where radio contact with the destroyer does not exist *the helicopter pilot may not be able to leave the scene* and circle at 200 feet to indicate he needs assistance. In such a situation he signals that he needs help by turning off his red rotating beacon. The destroyer commander then determines the best method of rendering assistance.

When a pilot is down at night, the destroyer commander may find himself in a supporting role as the helicopter commences the rescue. In a recent rescue while the helicopter was over the survivor, a destroyer crewman thinking that he was helping to illuminate the scene, aimed a searchlight toward the helicopter. In so doing he blinded the helicopter pilot who nearly lost control of his aircraft and had to wave off, coming perilously close to the water in the process. Destroyermen should not throw searchlight beams on the scene unless requested to do so by the helicopter pilot.

In the effort to help destroyer searchlights can sometimes blind the pilot, destroying his night vision.

One recently-developed emergency method of helicopter rescue is known as the "parachute snatch." Destroyermen should be familiar with this method of rescue since they can become involved in it. When for any reason the helicopter pilot is unable to effect a conventional rescue of a pilot whose parachute is still attached, he lowers a grapnel or a three pronged rescue seat and snags several parachute shroud lines and lifts the entire parachute from the water with the pilot dangling from the other end.

Once free of the water the helicopter pilot flys to the nearest ship and deposits the rescued pilot and parachute on deck. On a destroyer this transfer takes place on the fantail. As the rescued pilot is lowered by the hovering helicopter, deck crewmen grasp him firmly to prevent further injury since the helicopter pilot may not be able to hold a steady hover. The dangling pilot could well be dashed against the many obstructions on the deck. The parachute canopy is

hauled in fast and held to prevent its flailing due to rotor wash. *It is very important that the parachute not be detached from the pilot first because a freed parachute could billow up into the helicopter's main rotor blades and cause it to crash on the fantail.* After the parachute is secured, the grapnel or rescue seat is unhooked from the hoist cable, freeing the chute from the helicopter.

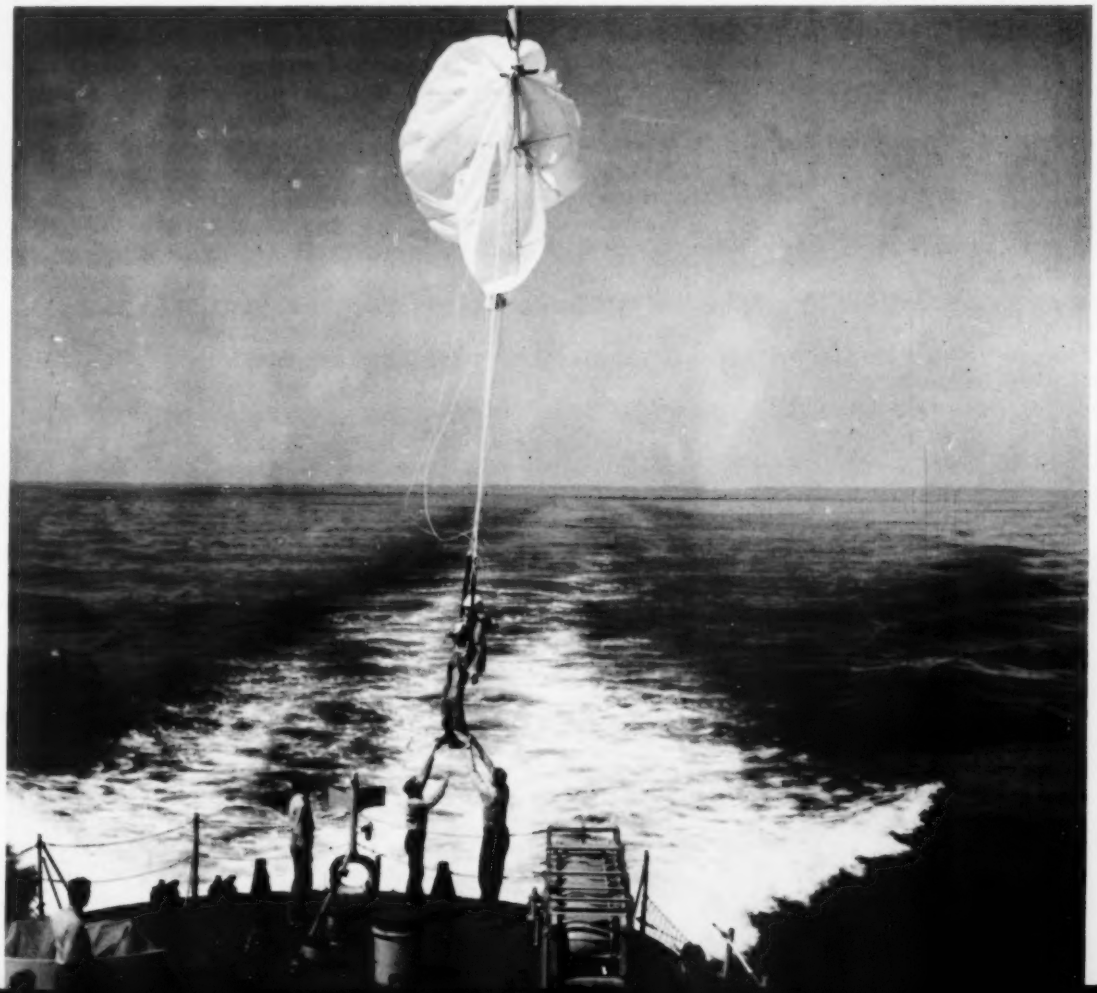
The "parachute snatch" method is used by the helicopter pilot only when other methods have failed and the pilot is in danger of being lost. There have been many practice parachute snatches using a dummy, but only one with a pilot. Unfortunately in the latter case the pilot was not alive when deposited on the deck of a carrier. He died from injuries sustained before he was picked up.

Successful rescue at sea, regardless of the method employed, invariably depends on people—people such as rescue swimmers, line tenders, bow hooks, lookouts, coxswains, bos'ns, and their supervisors. Like any other team effort, a failure by any one of them can spell disaster.

With new aircraft, new rescue equipment, new pilot's survival equipment, the state of the art of rescue is constantly changing. Thus, every man associated with rescue must recognize the important part he plays in this deadly serious business and make every effort to stay up with the times.

Destroyermen whose business it is to rescue aviators from the sea are employed in a most noble pursuit. Those who have been privileged to haul a water-logged but live and kicking pilot or crewman from a hostile sea will testify that there are few things more satisfying.

When all other methods fail, this emergency helicopter technique may be used. Fantail crews must know what to expect.



Shroudline Tangle

notes from your flight surgeon

AN F-3 (F3H) caught fire during a cat shot, probably due to a fuel cell rupture. The pilot ejected at 11,000 to 12,000 feet at 170 knots. Here's his description of his ejection and rescue:

"I went out with my feet on the pedals, helmet visor down. I positioned myself in a hurry but, I believe, correctly. Ejection shock wasn't quite as bad as I had expected. The parachute opened without delay—I looked up and saw it. My second survival knife which I carried in a leatherette pocket sewn to my anti-G suit on my right thigh was dangling loose. I reached down to get it, but it fell away. Although my helmet visor had one crack down the center, it was still in one piece and I pushed it into the helmet.

"Then I loosened my right seat strap to free my PK-2 container. (*He should have released his left rocket fitting instead of the right.*) The raft fell out of the container and began to oscillate rapidly. The lanyard with which the survival packet was attached to the raft was caught on my Mk-3C life preserver. I attached the yellow raft lanyard to my Mk-3C fasteners. (*In accordance with current instructions the lanyard should be attached to the lower torso garment fitting.*) Looking down, I saw that my other survival knife on my integrated harness strap and my pistol under my left arm were both there. I had freed my oxygen mask and dropped it after I had my visor up. I oscillated while hanging in the straps and I became slightly nauseated. The raft was swinging so violently that I finally pulled it in and held on to it with my left arm. . . . Below I could see where the plane had hit the water.

"On the way down I took off my gloves and put them in my anti-G suit right leg. Just prior to hitting the water I dropped the raft and held on to the rocket fittings of my harness. As soon as I hit the water I released the fittings with no trouble and immedi-

Vest and Raft Troubles

AFTER a UH-34E (HUS-1A) ditched, one of the passengers required assistance to inflate his life vest orally. He was not familiar with the necessity for tightly screwing down the CO_2 cartridge container caps. The cartridges were punctured but the CO_2 escaped to the outside. Oral inflation of the vest provided enough buoyancy to keep the survivor afloat.

The same accident had an unusual Murphy. For unknown reasons the rivet from one of the inflation toggles on a second passenger's life vest fell out shortly before the accident. The passenger replaced the toggle with a small nail from his tool box for a rivet. Because he was not familiar with the correct position of the toggle, he reinstalled it upside down thus cancelling the toggle's designed function. Fortunately, the buoyancy from the chamber that did inflate was sufficient to float him.

The life raft in this survival situation was lost when the floating raft pack was pulled under water. The raft was connected to a separate survival pack by a 15-foot lanyard which apparently became entangled in gear aboard the sinking aircraft.

Fortunately, all survivors were aboard a rescue ship within five minutes of the ditching.

Flares Unreported

IN A recent helicopter emergency landing near a naval air station, the pilot fired eight flares at passing aircraft with negative results.

At least one of the pilots saw the flares but passed it off as practice SAR training. (There was a possibility that the other pilots were concentrating their attention on landing as the point from which the flares were fired was just prior to a normal turn to base leg.) In addition, a group of civilian road construction men less than a half-mile away failed to take particular notice of the flares.

The possibility of civilian nonaction in cases where emergency signaling devices are displayed is understandable—though it's a good subject for PIO people to include in their next Open House or Armed Forces Day plans. However, service personnel, especially

ately pulled both toggles on my Mk-3C.

"My parachute canopy was 5-6 feet ahead of me on the surface. It had a few air bubbles but it did not blossom. I was dragging the raft toward me when I noticed the angel coming. When I started to paddle away from the chute I discovered my right foot was tangled in 4 or 5 shroudlines. I reached for my survival knife but had a hard time getting it *because my life vest covered it.* Finally I freed it and cut the shroudlines under water; I cut the middle finger of my left hand and punctured the lower cell of my life preserver in the process.

"When I paddled away, I discovered I was still attached to the raft so I stopped and disconnected the lanyard; then I finally paddled free and climbed into the sling the angel had dropped. I was hoisted aboard without any problem although I felt a little weak. The angel returned to the ship and I walked to sick bay. . . ."

in the vicinity of a military field, should be adequately indoctrinated via the station newspaper, posters and other available media.

The assumption that an emergency signal does not indicate an emergency can be a very costly mistake.

Flight Deck Accident

DURING flight deck operations, a plane director was blown by jet blast into a nearby aircraft awaiting launch. The blast picked him up and slammed him against the aircraft nose gear with what a witness described as a "frightful impact." Although the director was knocked unconscious, his injuries were only bruises, cuts and a minor concussion.

Continued emphasis must be placed on the dangers of jet blast. Safe flight deck operations require the full attention of all personnel at all times.

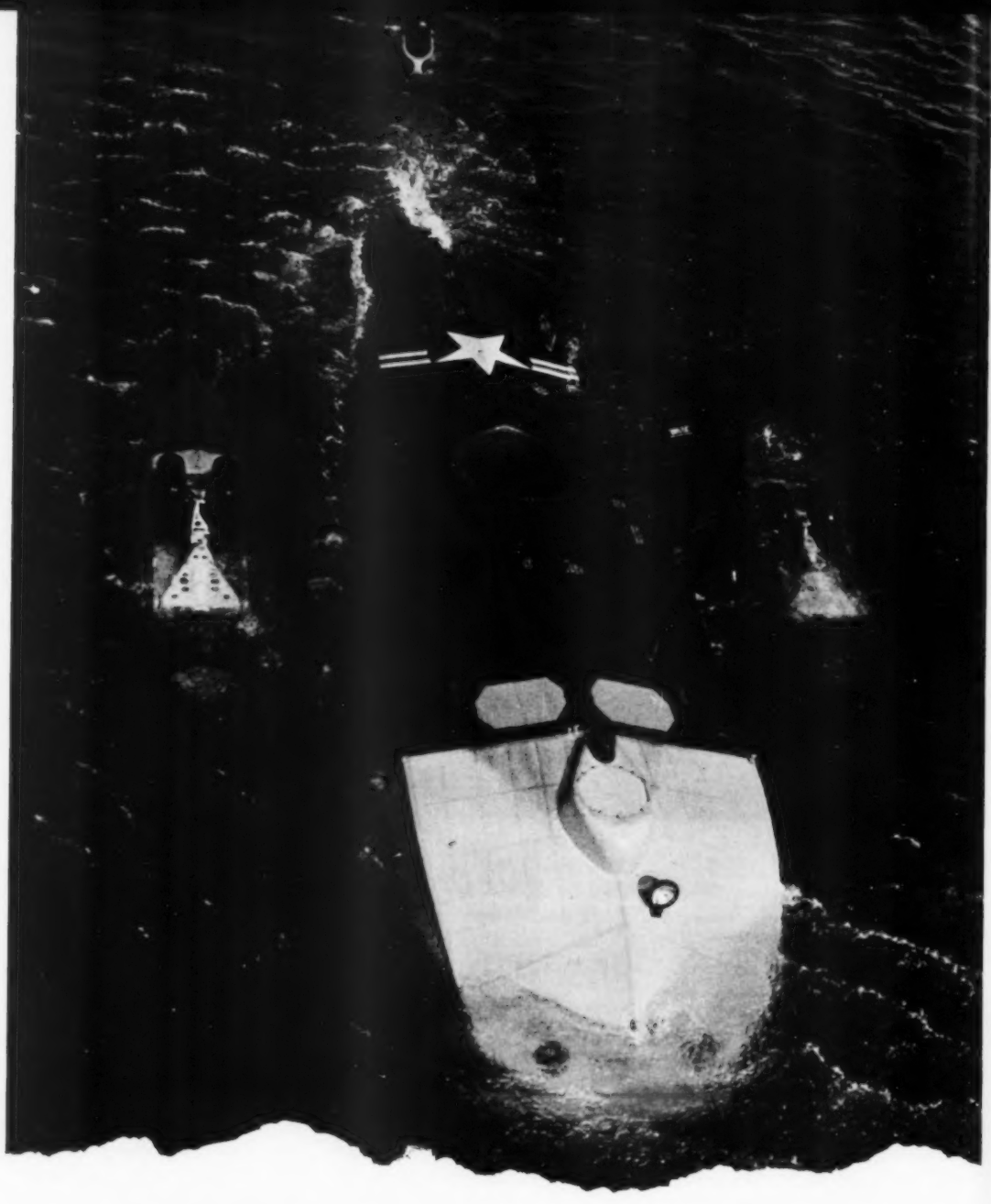
Excellent Self-training

FIRE broke out when the high pressure fuel line ruptured during pre-takeoff check of the fuel system of a TF9J(F9F-8T). The pilot secured the engine fuel master and start master switch, opened the canopy and informed ground control he was on fire. Both he and the dual pilot got safely away from the aircraft.

The dual pilot's efficient exit was due to his own emergency ground exit training system. Every time he gets out of an airplane he does the unstrapping as though it were a true emergency. He waits until his aircraft is shut down and chocked. Then with a mental "GO" he does the complete unstrapping as rapidly as possible.

Gear Adrift

A squadron maintenance officer was supervising plane captains and trouble shooters on the flight deck during launching operations. The jet blast of a taxiing F-1 (FJ) picked up several wheel chocks stacked on a projection of the edge just forward of the No. 2 elevator and blew them down the deck. One of the chocks struck the maintenance officer on the right lower leg and fractured both bones. ●



WASH or PIT?

By W. C. Pechnik, BuWeps, FWAE 422 and
Bruce Hoffman, G.E., T58 Product Service

Chopper jet engine life and mission capability depend on corrosion control

This $600,000 helo dunking could have been prevented had the recommended engine corrosion preventive maintenance procedures been followed. This helicopter suffered an "in hover" power loss caused by the failure of an engine component due to extensive corrosion.

With the advent of high performance gas turbine engines as power plants for the new helos, salt water ingestion and corrosion prevention should become a way of life for squadron maintenance personnel. Failure to comply with the instituted procedures could result in a possible repetition of the unfortunate incident pictured here. Officially, for the General Electric T58 engine, this procedure is titled the "Corrosion Preventive Maintenance Procedure" and is described in Section IV of the engine HSI. The procedure is better known to the Fleet units as "Wash and Rust-Lick."

Why is the procedure necessary?—and—What happens if your engines are not washed regularly? The answers are simple:

1. The procedure is necessary to remove salt and retard corrosion.

2. If the procedures are not followed, the engine overhaul cost to the Navy can be increased by as much as 400%. Under less fortunate conditions, corrosion can progress undetected to such severe levels over a period of time that component failure may result and an in-flight power loss can occur.

The "Wash and Rust-Lick" Procedure

A BuWeps-sponsored development program was conducted at Key West, Florida in 1960 and 1961 to determine the nature, effects, and required corrective and preventive measures which could be utilized to assure maximum mission capability of the T58 engine in the helicopter ASW or ASR environment. From this program a relatively simple method of salt deposition removal and corrosion control evolved —the Water Wash and Rust-Lick Procedure. Rust-Lick 606 is the trade name for a light brown, kerosene-based fluid available in 5 to 55-gallon units from Rust-Lick Inc., 755 Boylston St., Boston 16, Mass.

To obtain maximum benefit from Wash and Rust-Lick, it is necessary to use the tools recommended and provided for that purpose. Washing the engine with a uniformly distributed spray of fresh water removes the dried salt deposits from the compressor. When the three gallons of water are ingested through proper use of the applicator, the initial spray contacts the blades, dissolves the salt, and carries it through the engine. The continued spray entering the compressor completes the wash and provides a clean wetted surface for the adherence of Rust-Lick. Fresh water, free of contaminants and excessive mineral content, should be used. Because some of the water remains in the engine compressor and combustor, corrosion-accelerating deposits must be kept to a minimum. Thus, the cleaner the water ingested, the fewer corrosive agents remaining in the engine. It is equally important that the water flow be uniformly distributed and should not be concentrated in one sector of the compressor inlet. As the water spray progresses through the compressor it spreads out, dissolving the salt as the droplets move rearward. This dispersion, or spreading out, of the droplets due to the natural character of the compressor airflow is not completed until the flow has progressed to approximately the fifth stage of compression. Therefore, to adequately wash the first four stages, it is necessary that the water be ingested at several points around the inlet area.

The wash applicator was designed to provide an evenly distributed flow of approximately three gallons of water during the 20-second minimum ingestion period. At the ingestion cranking speed of 10-12 percent, the water is dispersed completely in the first stage of the compressor. If the water pressure is less than 45 psi, because of a pressure malfunction or inadequate priming; or the cranking speed is below 10 percent during ingestion, due to a marginal starter or low battery power, the wash will probably be ineffective in removing the salts from the engine.

Likewise, the preservative (Rust-Lick) applicator is designed to provide even distribution in a minimum period of time. To assure adequate blade coverage, the Rust-Lick must be ingested while the engine is operating at the normal starter cranking speed of at least 19 percent. The initial cranking time prior to Rust-Lick ingestion is used to purge excessive salt bearing moisture or condensation from the engine. Experience during the Key West phase of testing demonstrated that approximately 6 ounces of Rust-Lick must be applied under at least 40

pounds pressure for adequate penetration and distribution. If an aerosol can is used or a cupful of Rust-Lick is merely thrown into the compressor inlet, the coverage does not extend beyond the first three or four compressor stages and the resulting corrosion protection is ineffective. Many activities have set up as a rule-of-thumb that the Rust-Lick will be ingested until it appears at the engine exhaust in the form of a finely distributed mist.

Remember, moisture and salt laden particles are present in the air near a large body of sea water. This salt laden air enters the engine whenever the inlet and exhaust covers are removed. It is not a question of whether salt water enters the engine during over water flight but more precisely: *How much enters!* Also, it does not matter on board ship whether the engine is operated in a hover, or a cross-country flight, on the flight deck only, or in the test stand on the elevator or fantail. The only difference between these conditions is the *quantity* of salt ingested. For adequate corrosion protection, this salt must be removed and the Rust-Lick preservative coating applied on a systematic and periodic basis.

Studies of the helicopter hovering over salt water during the Key West program showed the aircraft surrounded by a large torus, or ring, of salt spray. See figure 1. In the figure is seen a circular area in the water below the aircraft about the size of the helicopter rotor. This is a low velocity region where the rotor down wash is deflected to form an outflow profile which extends in all directions from the helicopter. The frothy white ring of agitated water surrounding the outflow profile results from the high velocity outflow of air in contact with the water surface. It is here that water droplets are formed which are carried into the helicopter rotor flow system. Note the frothy ring around the helo is distorted downwind by the wind velocity. In figure 1, with a wind velocity of 9 knots, the ring is distorted to a distance of one rotor diameter forward, two diameters on the sides, and three to four diameters astern.

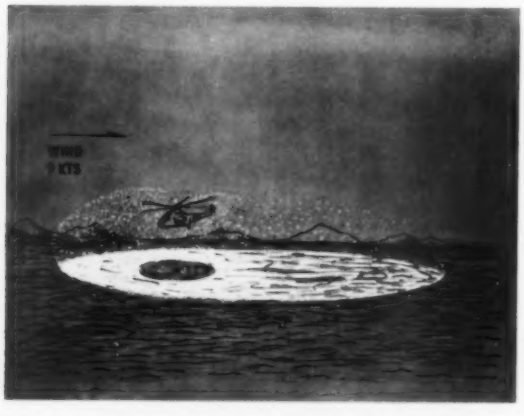


Fig. 1. Chopper is surrounded by a ring of salt water spray.

Once the water droplets are formed and made a part of the rotor flow system, the path traveled depends on aircraft speed, aircraft attitude, wind velocity, sea state, and aircraft altitude above water level. Figure 2 shows three aircraft attitudes and water flow paths as affected by wind velocity. In figure 2a, representing 2-8 knots, the rotor is tilted forward slightly to hover in a fixed position. In this condition there is a clear tendency for the air to sweep the surface and curve upward to the rotor inlet. The water droplets form a pattern similar to a doughnut with the helo in the center of the hole. This is the situation in which the maximum number of droplets are carried into the rotor air flow pattern. Engine operation verifies extensive salt water ingestion under this condition since the heaviest salt deposits and maximum performance deterioration are noted with 2-8 knots wind and at an aircraft altitude under 30 feet.

In figure 2b the helo attitude in hover is shown in a 20-knot wind. Here the rotor plane attitude and wind cross-flow distortion blow the salt water droplet pattern aft resulting in relatively little salt water ingestion.

In figure 2c a condition of zero wind is shown. There is a tendency of the rotor turbulence to scrub the ocean and radiate outward with little inclination to rise to the aircraft level. It is concluded that water surface tension in a calm sea (no waves to help churn up the water) is a major factor influencing the resultant flow pattern.

Engine Performance Effect

Observations were made to determine the quantity of salt water ingested into the engine under the different sea states and at various altitudes. It was shown that above 30 feet the rate of ingestion was essentially the natural salt content of the air, and was in crystalline rather than droplet form. Below 30 feet the rate of ingestion increases in proportion to the decrease in altitude. At 30 feet approximately three cubic centimeters of salt water per minute are ingested; at 20 feet the rate is 3 to 8 cubic centimeters per minute.

As the salt entraining air enters the engine it is continuously accelerated through the compressor.

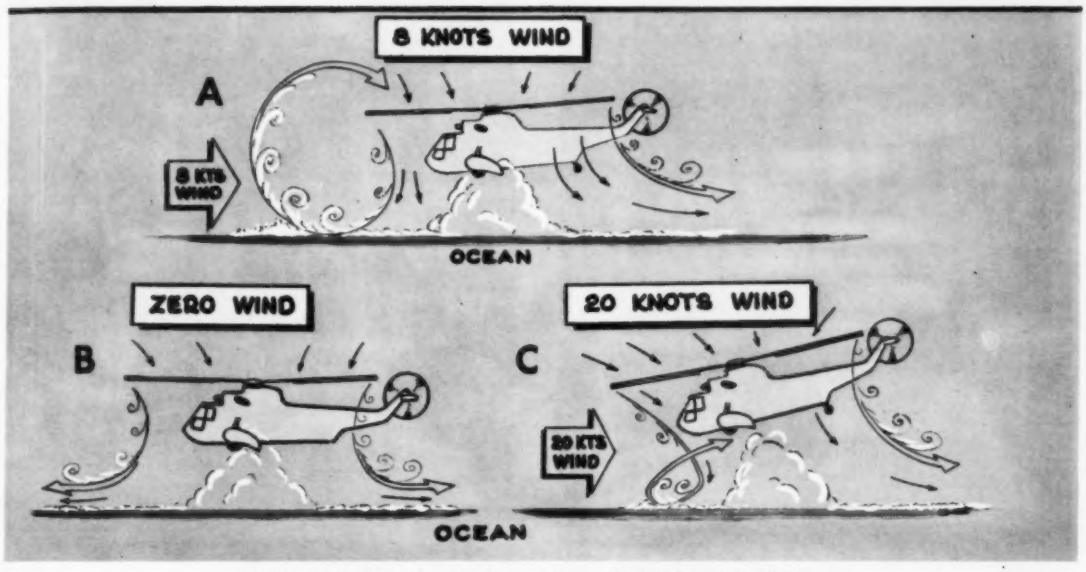


Fig. 2. Attitudes and water flow paths as affected by wind velocity.

Since the water droplets are heavier than air, they tend to strike the surface of the blade airfoils. The larger the water droplets, the better the chance of striking the blades. As the droplets wet the blade surface they spread out and begin to evaporate. The resulting crystalline particles are attached to the compressor blade surfaces with an extremely strong bond.

Engine performance losses can result because of these salt deposits in the compressor. The deposits make an irregular airfoil surface (figure 3) which, in turn, decreases the compressor efficiency and the power output of the engine. Under the most severe conditions (20 feet or less altitude and 7-10 knots wind velocity), tests have shown that engine performance could deteriorate sufficiently to significantly effect mission capability within four hours of hover over rough seas. Because ingestion increases with decreasing altitude, it likewise follows that the rate of performance loss increases as the altitude decreases.

It was conclusively demonstrated during the Key

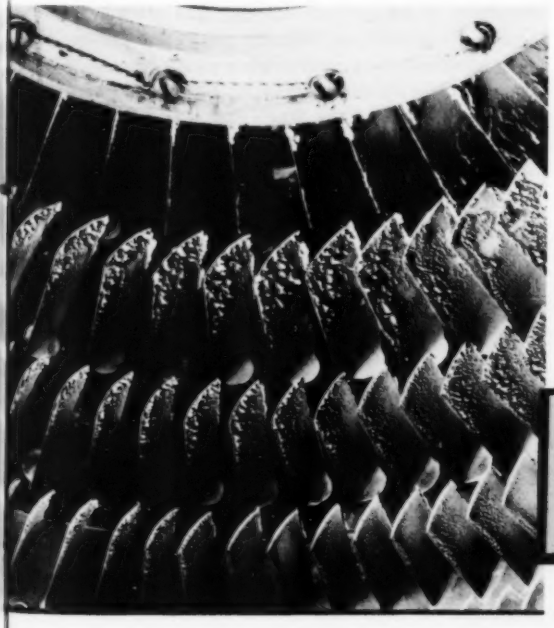


Fig. 3. Salt deposits cause irregular airfoil surface.

SALT DEPOSITS ON T58 STATOR VANES AFTER ACCELERATED SALT DEPOSITION TEST

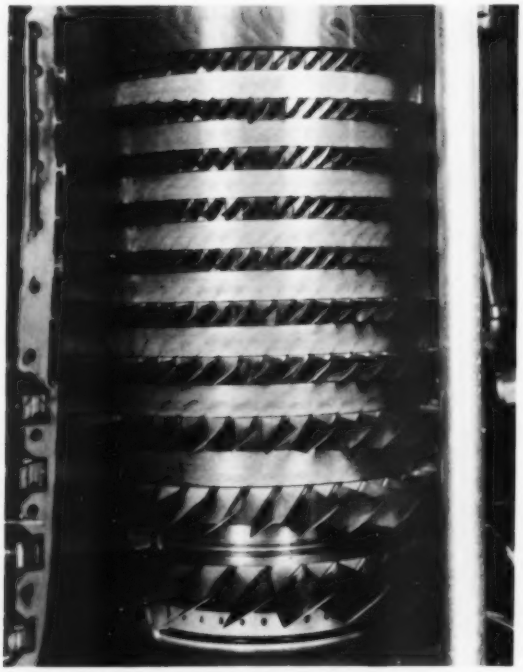


Fig. 4. Five months service with wash.

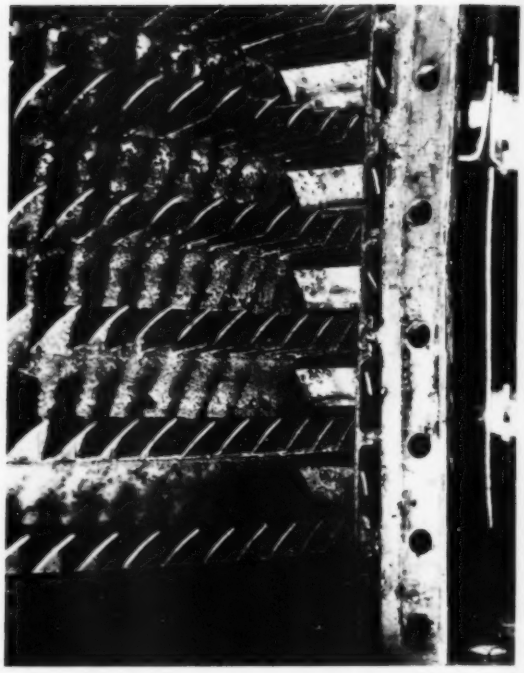


Fig. 5. Five months service without wash.

West tests that strongly bonded salt deposits could be removed from the engine flow path surfaces by a fresh water wash. When washed within prescribed intervals, the engine power was restored to that of a clean engine.

Corrosion

Any salt deposits in a jet engine can be harmful if not removed promptly. This is especially true of the sodiums and phosphates found in sea water. All stainless steels and other iron containing alloys used in modern jets for needed strength and service life are subject to salt water corrosion. Whenever a salt particle adheres to these metals in the presence of moisture, corrosive attack will commence. This corrosion will continue to progress and multiply until:

- All moisture is removed (zero humidity).
- The salt and water are removed from the metal by mechanical methods (brushing, blasting or erosion).
- The salt and water are displaced by chemical means (Water and Rust-Lick).

Figures 4 and 5 are photographs of uncoated engine compressors which were subjected to ingestion of salt laden atmosphere over a period of five months operation. During this time about 90 percent of the operation was in hover within 30 feet of the water surface. The compressor in figure 4 was maintained by daily Wash and Rust-Lick. The compressor in figure 5 received no maintenance and shows the deterioration effects of ingestion and advanced stages of corrosion. A comparison of these figures proves the effectiveness of the Wash and Rust-Lick. I would rather fly in a helo having the power plant from figure 4 installed. How about *you? ? ? ?*

The first stage of corrosive attack is a staining of the metal surface under the salt and water deposits. This stain will appear visually on unprotected metal surface areas from one to six hours following engine shutdown. The time difference depends on the water content of the outside air (humidity), the outside air temperature, and how fast the engine part cools after engine shutdown.

Stain, in itself, is not considered serious since it is easily removed by natural abrasives in the air when the engine is operated normally, and is prevented from proceeding further through use of the Wash and Rust-Lick.

The danger with staining is that it is followed by the next step in the corrosive attack—*Pitting!* A

pit is a crater or hole in the surface of the metal. It is caused by a physical eating away of the metal surface by the salt water. Figure 6 is a photograph of a compressor airfoil severely damaged by corrosion. This airfoil received little or no maintenance/preservation during a three-month service tour. The surface is heavily pitted and is typical of corrosion attack on certain stainless steels.

Laboratory testing of blades from unwashed engines with this degree of pitting show an unacceptable reduction in metal strength. In all cases of laboratory induced failure, the resulting fracture was located through a substantial corrosion pit which represented the area of highest stress concentration. The pitting limits reflected in the Service Instructions and Overhaul Manuals are based on hundreds of pitted blade fatigue tests which were conducted on airfoils corroded in actual fleet type operation. Again, it was shown that blade pitting could be virtually eliminated by routine application of the Wash and Rust-Lick procedure. Rust-Lick is a water displacing, corrosion preventive fluid. Ingredients in the Rust-Lick disperse and replace the water droplets, placing a protective coating of oil between the water and metal surface. Each pit is a stress concentration which reduces the life of the affected part to some degree. In determining the seriousness of pitting and safe limits of operation involved, the material content, the job the part is performing, the physical size of the part, and the operating loads in the pitted area must all be considered. For example, a casing which is not highly stressed during operation, but must be one half inch thick for manufacturability, could withstand deeper and more widespread pitting, or other mechanical damage, than a thin, highly stressed rotor blade or disc assembly. A given pit, of say, .015 inches deep (roughly 1/64-inch) may extend 3 percent of the metal thickness into the casing: but this same .015 pit may have eaten away as much as 75 percent of the blade airfoil thickness at the pit location.

Fig. 6. Corrosion after 3 months of service.

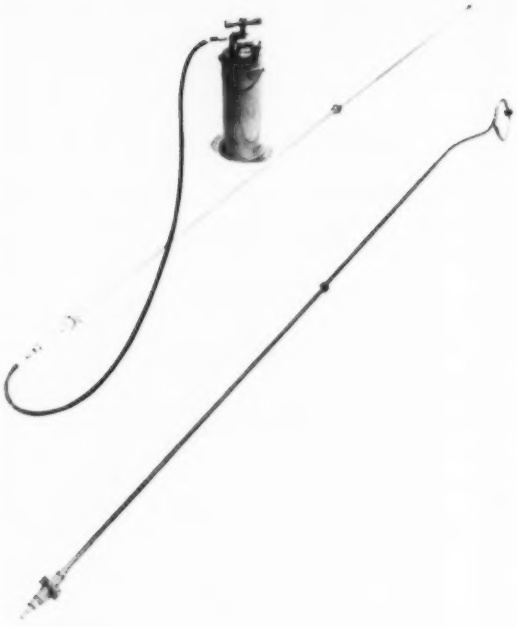
Wash and Rust-Lick can stop pit progression when used daily, but there is no maintenance procedure which can restore the original metal surface by filling in the pits. The damage is permanent. *There are no "putting on tools."*

Coatings

One means of retarding the corrosive attack of the salt and moisture deposit is to place a protective coating on the base blading metal. In the search for an adequate coating, an industry wide survey was conducted. Of the materials available, all but sixteen were eliminated as unsatisfactory prior to engine or laboratory evaluation because of inferior temperature characteristics, adverse effect on metal fatigue life, poor erosion resistance, or difficulty in application. Of the sixteen, eight were proven unsatisfactory by further laboratory testing. The remaining eight were tested in two special compressors as a part of the Key West program. A Nubelon S and Aluminum Silicone combination proved most desirable and was chosen for production. Actual engine test of Nubelon S in the T58 engine revealed adequate protection in the first five compressor stages but temperature deterioration of the coating occurred in the rear stages. Aluminum Silicone, with better high temperature characteristics, was selected for these aft stages. The Navy elected to use only one coating at overhaul and has recently decided on Aluminized Nubelon—an improved version of Nubelon S.

A big deficiency with any coating of this nature is its relative sensitivity to erosion. The coatings are continually eroded by the natural ingestion of abrasive particles in the air such as sand, dirt, coral, etc. As the coating is gradually removed, the bare metal surface is exposed to the salt water.

We therefore conclude a protective coating is a temporary means of protection, with the sole purpose of retarding the progress of corrosion during the service tour of the engine. Note that we say "retard," not "prevent." Because of the erosion and temperature limitations of the coatings, the operating life of the coating is limited and corrosion may appear where the coatings have deteriorated. Only the Wash and Rust-Lick has been effective in keeping corrosion at a minimum on uncoated metal surface.



For effective Wash and Rust-Lick, use the tools recommended and provided for that purpose.

Corrosion Resistant Materials

A change in the basic blading material has also been investigated. Many materials were immediately rejected because of poor corrosion resistance properties or inferior fatigue strength. Included were many materials used on other gas turbines which could not be used because they could not reasonably be manufactured to meet the light weight design characteristics of the engine or were too weak for satisfactory performance at T58 engine operating temperatures. The search for a new, better material is a continuing program. As new materials or coatings are developed they are evaluated for use in the compressor. However, introduction of a new material would not mean deliverance from the Wash and Rust-Lick procedure. Even though the corrosion resistance of the parent material could be increased considerably, it would not reduce the amount of salt ingested or its deleterious effect on engine performance.

Remember: It is necessary that you of the new Turbine Helicopter Fleet keep salt deposition to a minimum, thus assuring mission capability, long life engine serviceability and minimum corrosion. To lower overhaul costs and prevent premature component failures—

You must:
- Wash Daily
- Use the right equipment
- Follow the Manual

About Injuries

"About 88% of our accidents were still due to unsafe acts on the part of injured employees. Although we are not unmindful of the fact that each employee has a responsibility to work in a safe manner, many of these were acts which we as supervisors could have controlled. There is nothing complicated about it. For example, when we take action against reckless driving of mobile equipment, we have fewer accidents; when we enforce proper rules on handling of fuel and other flammables, we will reduce the chance of fires; when we demand the use of goggles on grinding and overhead drilling operations, we will have fewer eye injuries; when we insist on the prompt clean-up of oil spills and grease spots, we will have fewer falls; when we pay attention to proper lifting procedures and materials handling we will have fewer strains and sprains. *It is usually as simple as that!*" —*Mechanics Bulletin*

Touche'

AFTER a local flight the pilot wrote this discrepancy in the aircraft form, "Something loose in tail." The next morning when he returned for another flight in the same bird, he found this reassuring corrective action entered by his write-up. "Something loose in tail tightened." Reminds us of some others making the rounds a few years back:

Pilot's write-up, No. 2 engine missing." Corrective write up, "Replaced No. 2 engine."

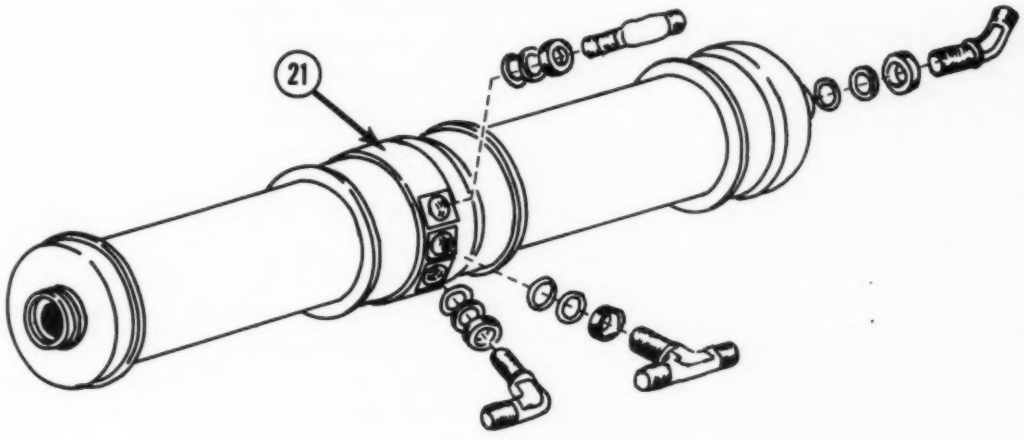
"Prop pitch control stuck 50 miles out." Corrective write-up, "Adjusted to 3 inches."

First flight write-up, "Left wing heavy." Corrective write-up, "Centered tab." Second flight write-up, "Right wing heavy." Corrective write-up, "Centered tab." Third flight write-up, "Both wings heavy!"

Brevity is fine, but explicits elicit more efficient fix-it.

MURPHY'S LAW*

* If an aircraft part can be installed incorrectly, someone will install it that way!



Item 21 was installed *end for end* during reassembly.

Accumulator Blow-Up—F-1 (FJ)

FLIGHT Control Accumulator of an F-1E (FJ-4), would not hold pressure, so it was disassembled and all new gaskets, packings and rings installed. The accumulator was then assembled and reinstalled. It was preloaded with air to 650 psi. As soon as hydraulic pressure (system pressure 3000 psi) was applied there was a loud explosion. Two mechanics, one man on a check stand and one on the starboard wing were drenched with hydraulic fluid and knocked to the deck. They were taken to sick bay and released after examination—no injury; plenty scared.

It was discovered that Part No. 165 58115-3 Head Assembly, Hydraulic 60-cubic inch self-displacing accumulator (Fig. 132 Index 21 of the IPB) had been installed *end for end* (see drawing). This permitted 3000 psi hydraulic pressure to be ported into the area where return pressure only should normally be. Hydraulic pressure of 3000 psi exerted against the rod assembly drove the rod assembly through the cap. The rod parted directly under the nut (Fig. 132 Index 32 Part No. AN363C720. Although this check crew has a man by the name of Murphy in it, he was not involved in this in any way whatsoever, but *Murphy's Law* was. All personnel should be advised as to the proper methods to prevent this type of accident from recurring. Basically alignment marks on all mating parts plus thread count will take care of this problem. This holds true on practically all type hydraulic units, accumulators, actuating cylinders, oleo struts, . . .—*NAS Glynco Hangar Division Chief*

Cross-Wired Jets—P-2 (P2V)

DURING a demonstration of P-2 (P2V) jet emergency procedures the pilot pulled the port jet door solenoid circuit breaker. When the port jet throttle was moved to OFF the jet pod door closed instead of remaining open.

Troubleshooters found the port jet circuit breakers wired to the starboard jet and *vice versa*. The cross-wiring took place in the junction box located in the nose tunnel.

Though the aircraft was not placed in any direct jeopardy by this Murphy, a potentially hazardous situation did exist if jets had been operating and required and a fire occurred in one jet. Pulling reversed circuit breakers would allow the burning jet to continue to operate and flameout the opposite jet.

A further check of 11 other squadron aircraft

revealed 5 of them wired in this condition.

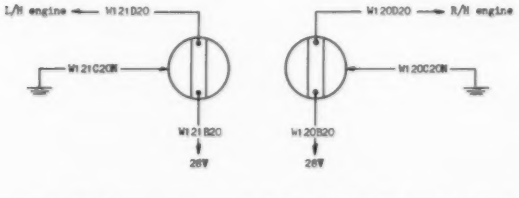
It is recommended whenever work is done on wiring involving the jet control circuit breaker panel that proper continuity tests be made to determine that circuitry functions as intended.

R3350 Chip Detector Warning Light Reversal—P-2 (P2V)

AN ITEM has just come up for the second time in less than a year and this time it could well have caused a loss. The engine sump warning lights were *reversed*. With a failure on one engine and the reported warning on the other, a panic type pilot could well find himself without power from either engine. The following is quoted from the second report:

> The port sump warning light came on while the aircraft was at maximum distance from land. No decision was made for a few minutes while checking the other gages, then the starboard engine began to require more manifold pressure to sustain 101 torque. The cylinder head temperature began to rise uncontrollably, and backfiring ensued. At this time, the starboard was feathered, and the port was prayed for. The trip back was uneventful. On the ground, it was found that during overhaul the port sump light had been wired to the starboard engine and *vice versa*.

The following shows the correct connection for port and starboard engine warning light leads as viewed from the cockpit.



It is highly recommended that all P-2s be checked against this condition as soon as possible.

Same Song, Verse Two C-1A (TF)

IN FLIGHT, the port engine chip detector light came ON. The pilot of the C-1A (TF) feathered the port engine. After landing safely, an inspection was made of the port engine sump. No metal present, yet, the warning light stayed ON. Troubleshooters then looked at the starboard engine sump—you guessed it—metal was there and so was an example of Murphy's Law. Wires from the sumps had been crossed in the cannon plug behind the cockpit lighting panel contrary to the schematic diagram in Manual 01-85SAA-2, Figure 10-25A-1.

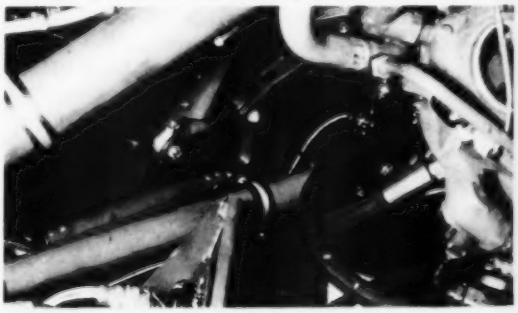
Besides making a one-time inspection to determine whether wires are crossed it is strongly recommended that whenever maintenance is performed on the magnetic chip detector system, it be tested electrically for continuity to the indicator involved.

Reversed Bellcrank—SH-34G (HSS-1)

DURING preflight of an SH-34G (HSS-1) the pilot noticed that one blade was not following the motion of the collective pitch stick as it was moved FULL THROW to ensure complete freedom of movement and full travel.

Inspection of the flight controls found Rod Assembly, S1640-62166, Figure 86, Item 126 of NA 01-

IMPROPER installation of the Bellcrank P/N S-1640-61294. Note broken Rod Assembly attached to the Lateral Servo Unit.



PROPER installation of the Bellcrank as attached to the Left Lateral Servo Unit.

230HLA-4 SH 34G (HSS-1) IPB, was broken at the point of the innermost rivet on the Bellcrank end. This Rod Assembly and Bellcrank leads to the Left Lateral Servo Unit. Bellcrank, S1640-61294, Figure 86, Item 163 of NA-01-230HLS-4, was installed *backwards;* allowing the Rod Assembly to bind on the lip of the improperly installed Bellcrank when the flight controls were moved during flight. Excessive pressure on the Rod Assembly in this position caused it to break in area of rivets.

Had the pilot not been keenly aware and observant in noticing the lack of movement in the blade, or had the Rod Assembly held until the aircraft was in flight, a serious accident could have resulted.—*LT L. D. Moats, Aviation Safety Officer HT-8*

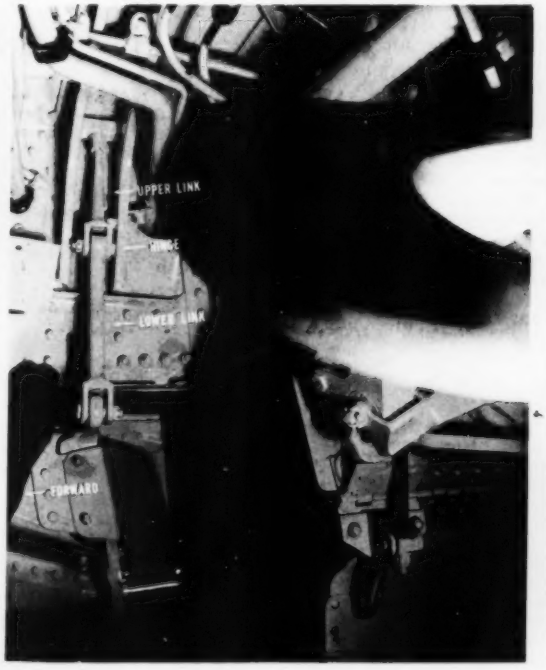
A4C (A4D—2N) Main Landing Gear Forward Door Preload Bungee

THIS MURPHY resulted by installing the *lower link* of the three-part link assembly on *backwards.* When hinged to the upper link clevis in this position, the lip of the lower link is meshed outboard of the hinge point, thus preventing the bungee from folding inboard and closing the forward main landing gear door. The *hinge bolt* was also inserted *backwards.*

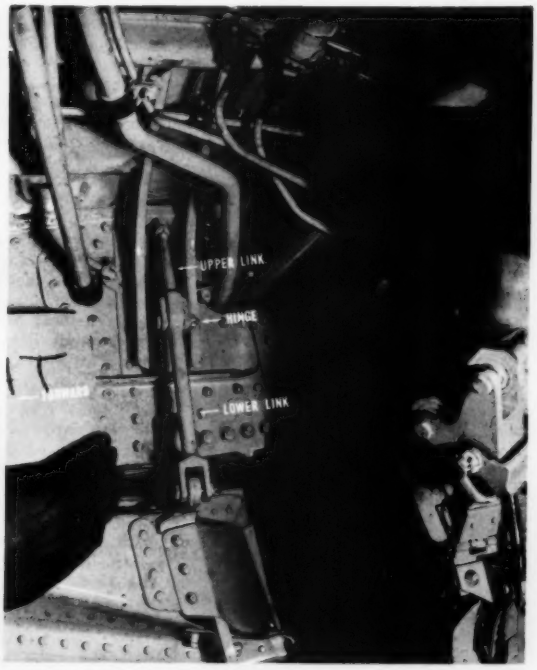
The gear was not drop-checked prior to test flight. After takeoff, the test pilot raised the landing gear handle and received main gear UNSAFE indications and a SAFE UP nose gear indication. He lowered the gear and made a normal landing with all indicators DOWN and LOCKED. After the Murphy was corrected the gear drop-checked satisfactorily. The aircraft was reflown without incident.

The lack of a corresponding warning note in the HMI indicates that a warning note should be appended to the applicable section of the HMI to preclude future Murphys of this nature.—*LT J. T. O'Der, VA-112 Safety Officer*

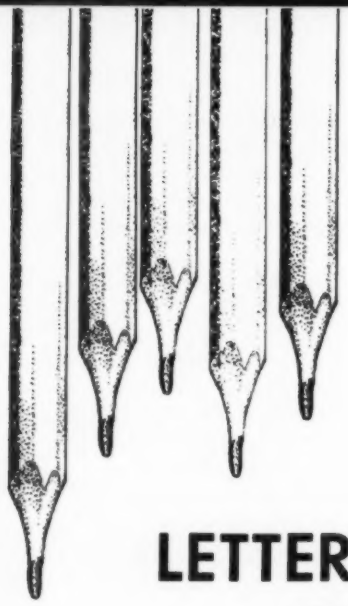
Concur: Errors and Omissions in naval aircraft publications should also be reported by FUR in accordance with BuWeps Inst 5600.18 of 3 Dec 1962. Meanwhile, insist on drop-checks.



BACKWARD installation of lower link. Note detail at hinge point.



CORRECT installation of lower link. Compare hinge detail with photo, left.



LETTERS TO APPROACH

Knife Location

FPO, New York—Regarding your article on survival knife locations (Jan 1963) I would like to contribute some thoughts for evaluation.

First, and a relatively minor point, I think that if the survival knife is located on the left, or buckle side of the torso harness chest strap, it is more convenient since the buckle tends to keep it there without sliding off when the harness is not being worn. Also it does not get in the way when tightening down the cross-chest strap.

Secondly, thought should be given to the location and manner of attachment of the shroud-cutter knife. Several recent AARs have proved, in the pilots' own words, the life-saving qualities of this knife. The main considerations in locating the knife should be rapid accessibility and instant readiness for use. This precludes locating it on one shoulder or the other since if the opposite arm is broken you are immediately in trouble. Therefore, the best location is on the front of the torso harness equally accessible to either hand. We locate it on the right side adjacent to the zipper and between Mk-3C and chest strap.

Instant readiness for use dictates that the shroud-cutter blade be kept open. (Who decided to put the flip-open button on the other blade?) The knife is then encased in a locally fabricated case with an ordinary snap-closure flap. A piece of nylon strap about 3″ long is attached to the ring on the end of the knife. The strap has a hole in it which slips over the snap fastener before snapping. Now all that is necessary is to pull on the nylon strap and you have the knife out of the case with little effort and ready for use. Also, light nylon line attaches the knife to the case to prevent loss if dropped. This nylon line is enclosed in a small separate pocket on the case to prevent inadvertent severing when withdrawing the knife.

This system of attaching the shroud-cutter is in general use in Air Group One and its development was a combined effort of several CVG-1 riggers. The pictures illustrate the manner of use.

H. H. LOVE, JR., LCDR
VFP-62 DET 42

• Thank you for your comments. Your squadron's procedures for wearing the survival knife and the shroud-cutter look acceptable here. Locally there is agreement with you on the flip-open feature of the shroud-cutter; it is felt that the knife should have a fixed open shroud-cutter blade.

Instant Anymouses

FPO, San Francisco—At an APM an instant Anymouse was requested from everyone present. Some of them were written in jest, while others were of possible value. Anyway, it exposed some people to the Anymouse program who had never written one before.

I hope some of them will be of use to your program.

D. A. PAGE, VA-165, ASO

• Thanks for the baker's dozen and the plug for Anymouse. You'll be seeing them in print.

Direct Readout

Patuxent River—The Service Test Division of the Naval Air Test Center has recently completed evaluation of a servoed counter-pointer altimeter (see photo).

While this altimeter was unsatisfactory in some respects, it incorporated a direct readout altimeter setting which was found to be quite desirable. The obvious advantage of this is the elimination of parallax and easier reading and setting of the proper altimeter setting.

A major improvement in the direct readout altimeter setting may be realized if the third and fourth digits, 9 and 2 respectively, could be painted a distinctive color, probably irridescent red or orange. It would be a tremendous aid to the pilot in two respects. First it would call attention to the fact that his altimeter was set at 29.92″, and second, it would reduce the pilot attention required to set 29.92″ in the window.

In the present three-pointer and counter-pointer altimeters, a distinctive irridescent marking at 29.92″ on the altimeter setting scale would be of similar benefit. The cost and complexity of such a minor modification must certainly be insignificant in comparison to one accident that may be prevented.

W. J. GEIGER, CAPT, USMC

First of the Firsts

NAAS Ream Field—In regard to "First Night Rescue" in Feb 1963, I would like to provide additional information, not in the spirit of questioning the "first of the firsts," but in acknowledgment to the individuals conducting this rescue. . . .

CDR C. L. Lee, who was attached to the USS KEARSARGE as O-in-C of HU-1 Det 20, rescued William D. Greynolds, AN. Greynolds was washed overboard by a large wave at 1802 M on 28 November 1955. A HUP-2 was launched at 1810 M. The rescue was completed by 1815 M. Sunset was at 1745 and it became dark by 1805 M. H. B. Fredrick, AD1, was the helicopter aircrewman for this rescue.

HU-1 records show an earlier night rescue which was conducted approximately 30 miles at sea on 1 May 1952. Cardoza, Henry, AD1 (AP), departed Ream Field in a HUP-2 BuNo 128482 at 1940 U and rescued LT W. D. Willis, who had ejected from an F9F 1½ miles southwest of the Los Coronado Islands. Sunset was at 1830 U. While this rescue was not made from a ship, it is the first night open-sea rescue on record at this command.

It is recognized that the opening remark to your article was intended to define "the first" so narrated as a rescue performed by the truly routinely night capable generation of helicopters.

W. C. CASEY, CO, HU-1
—A

Bullet holes were discovered during post-flight inspection in the rescue hatch of a UH-25B (HUP-2) after a local flight from a NAS located in the continental United States. This is an old but fortunately infrequent problem.

Good Show

Beeville, Texas—When a quarter-inch stud had broken off flush with a J48 engine case the problem was multiplied when an easy-out was broken off in the attempt to remove the stud.

Maintenance was faced with the problem of sending a good engine to an overhaul activity for repair or requesting that personnel with the proper equipment be sent here; all for one little stud. Then it was decided to try the Dental Department.

Dentists using dental drills and techniques removed the offending easy-out and the stud; and saved thousands of dollars in labor cost, shipping charges and lost engine time. This is a first for VT-25 and no doubt a first for a dental technician.

SIO

Flight Deck Shrapnel

FPO, San Francisco—The continued reporting of aircraft incidents and flight hazards resulting from tension bar fragments accidentally separating from the holdback fitting upon arrestment indicates a requirement for a design change for the A-4 aircraft holdback fitting.

After three aircraft of this command were exposed to the missile hazards caused by the tension bar fragments separating from the holdback fitting upon arrestment, this squadron, as an interim preventive measure, taped the tension bar into the holdback fitting with ordnance tape.

Numerous arrested landings have been logged by this squadron since using this procedure without the loss of a single tension bar fragment. Although the tape was occasionally broken or torn to some extent during arrested landing, the fragment was successfully retained.

Until a satisfactory change for the holdback fitting is incorporated, it is suggested that squadrons operating A-4 aircraft consider a similar interim procedure for carrier operations.

M. D. SHORT
CO, VA-163

• This is an excellent suggestion but it should be strictly considered an interim fix. The problem has been with us for many years and a design change to correct the situation is long overdue. We would be interested in hearing from other A-4 (A4D) squadrons to see how they are coping with the problem.

APPROACH welcomes letters from its readers. All letters should be signed though names will be withheld on request. Address: APPROACH Editor, U. S. Naval Aviation Safety Center, NAS Norfolk, Va. Views expressed are those of the writers and do not imply endorsement by the U. S. Naval Aviation Safety Center.

Completed File

Ridgefield, Conn.—I'm getting my 1962 magazines ready for binding. I'm missing the October and November issues of APPROACH. Please send one copy of each.

HARLEY D. KYSOR
Aeronautical Consultants & Associates, Inc.

• Happy to oblige.

Attn: Beech Drivers

Alameda, Calif.—Here's a photo which shows clearly the results of tossing a life vest over a TC-45J (SNB) heater vent in the passengers' compartment. We have had four such incidents in the past 14 months (NORIS has had at least two cases).

Our action in prevention has been to pass the word to all crewmen, and plane captains through their division officers; to pass the word to pilots verbally and in the Ops News Letter; and to post the subject picture in the line shack.

Since shrapnel does result and the smoke flare could trigger there is an obvious danger. And since I can't seem to get the word to our numerous and ever-changing CRT pilots, I need your help. Please publish this hazard in APPROACH.

W. A. ELLSWORTH, LCDR
Aviation Safety Officer

• Glad to help.

approach

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Flight Operations

1 Tower Times
by JACK LEBARRON

5 Blocked Runway

6 It's the Little Things . . .
by CAPT BILL GASH, USMC

10 An Ounce of Prevention
by LCDR M. B. NICHOL

11 Naval Aviation in the Years Ahead
by VADM FITZHUGH LEE

15 What's Your Angle?
by LT G. W. LUBBERS

23 It *Can* Be Done

24 Flight Deck Safety by the Numbers

Aero-Medical

26 Destroyer Rescue
by MAJ H. G. C. HENNEBERGER, USMC

Maintenance

36 Wash or Pit
by W. C. PECHNIK, BuWeps, FWAE 422 and BRUCE HOFFMAN, GE, T58 Product Service

43 Murphy's Law

Departments

20 Anymouse

22 Headmouse

34 Notes from Flight Surgeon

46 Letters

Inside Back Cover: Lift & Drag

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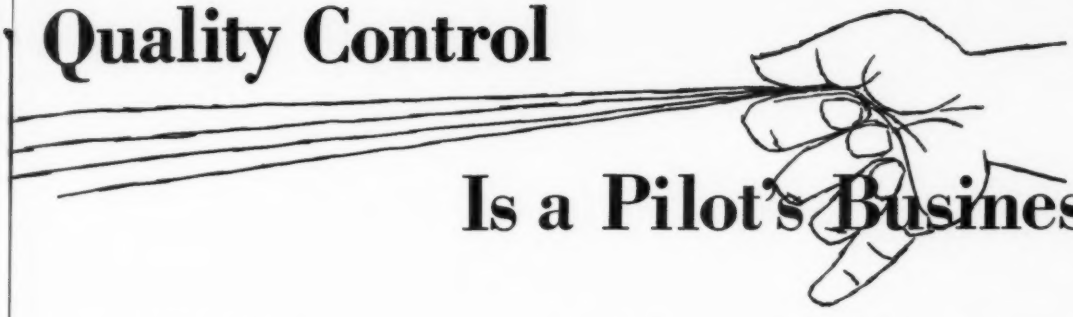
Our product is safety, our process is education, and our profit is measured in the preservation of lives and equipment and increased mission readiness.

Quality Control



Is a Pilot's Business

"OK for VFR flight only."

"Fuel transfer gage reads low. Next pilot check."

Do you have yellow sheets in your line shack with these or similar entries? If so, you are overlooking an important area in your aviation safety program, and one that can put your accident board to work before you know it.

In this era of high performance machines, each aviator is entitled to an aircraft that is as mechanically sound as human effort can provide for each flight. How many times have aircraft accidents had their beginning in in-flight failures of aircraft systems or parts? It logically follows that a reduction in airborne failures will inevitably reduce the number of emergencies and subsequently reduce the number of accidents.

One aid to this goal lies in quality control and its total implementation. Mention quality control to the average pilot and you will draw responses varying from a blank stare to a mumbled statement that "It has something to do with maintenance." Agreed, the quality control billets are filled by maintenance personnel but the real heart of the quality control program lies in the pilot himself. Inclusion of all pilots in your squadron quality control program may be accomplished by the following:

1. Indoctrinate your pilots to the importance of correct and complete discrepancy reporting after each flight. Foster the practice of describing troubles fully without telling maintenance how to fix the aircraft.

2. Encourage pilots to follow up discrepancy reports with visits at the work shop level to ascertain what part actually did fail to function properly.

3. Pursue an active pilots' weekly aircraft inspection program and insure qualified technical aid is available during this inspection.

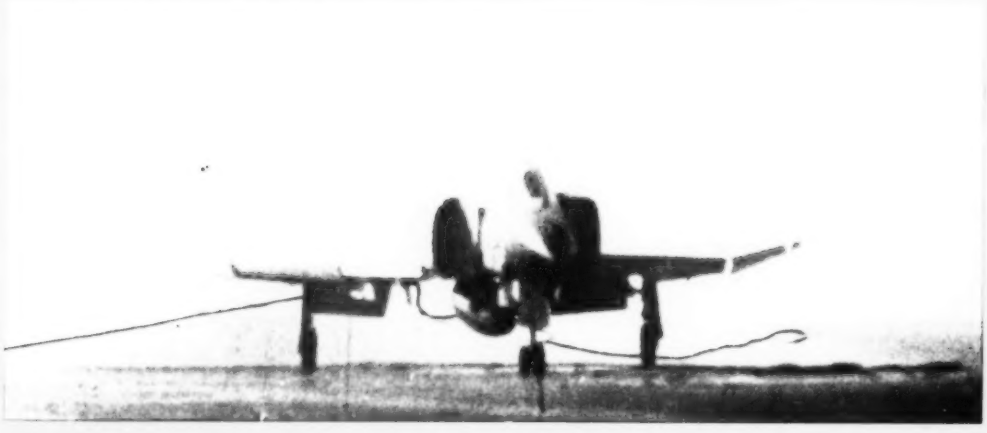
4. Review all aircraft systems at frequent intervals in your pilot ground training program to enable each pilot to intelligently report the performance of his bird on each flight.

The examples given are not considered to be the entire key to success in achieving the goal of good yellow sheet discrepancy reporting but do serve to emphasize the magnitude of the program. Additional benefits will accrue if sometime during the middle phase of a pilot's training cycle he is instructed in the factory flight check requirements for his model aircraft and then allowed to fly an "up" aircraft on a controlled "test" hop. After this flight, the pilot should turn in a completed post engineering check card to operations for review and comment.

The program of quality control is sound and offers dividends in the form of increased safety and operational efficiency if actively pursued by pilots and maintenance personnel alike. Give the next pilot of your aircraft a break by giving a factual and complete story report of the performance of the bird you just flew, and you will reduce the chances of putting him out on a limb about to become a statistic.

—LTCOL L. B. Matthews, Jr., CO, VMF-333

LIFT and DRAG



A carrier deck can be a dangerous place to work. When 15 tons of aircraft hurls itself at the deck of a carrier the unexpected might happen.

In this case the purchase cable parted causing loss of limbs to three people. A most unfortunate accident indeed, but as long as men deal with machines there will be malfunctions and accidents.

To lessen your chances of becoming a victim read and heed "Flight Deck Safety by the Numbers" page 24.